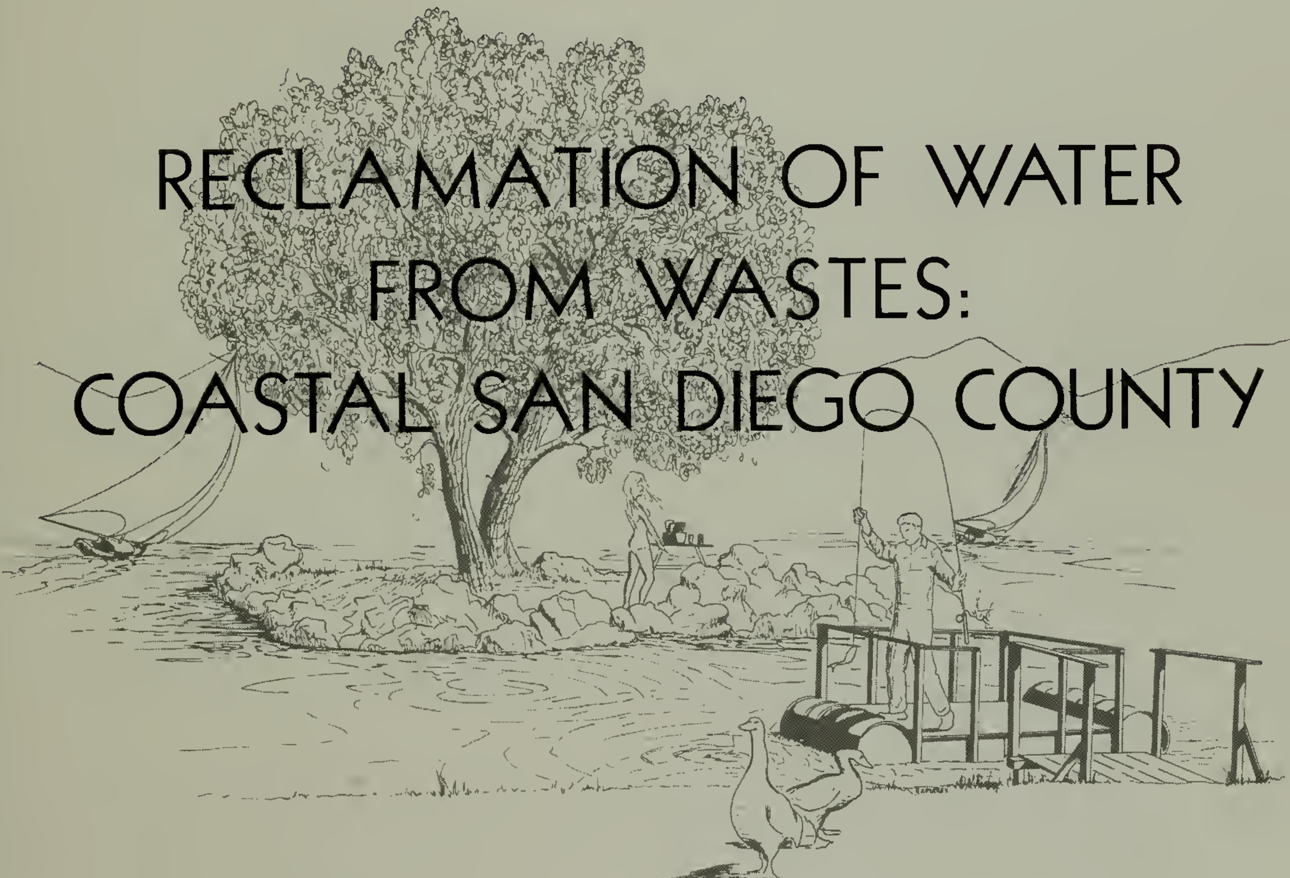
STATE OF CALIFORNIA
The Resources Agency

Department of Water Resources

BULLETIN No. 80-2

RECLAMATION OF WATER FROM WASTES: COASTAL SAN DIEGO COUNTY



FEBRUARY 1968

RONALD REAGAN
Governor
State of California

WILLIAM R. GIANELLI
Director
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FOREWORD

Bulletin No. 80-2, "Reclamation of Water From Wastes: Coastal San Diego County", is the second in a series of investigations undertaken by the Department of Water Resources in accordance with Section 230 of the State Water Code to investigate the reclamation of water from wastes for beneficial uses in specific areas of the State. The first report in this series was "Feasibility of Reclamation of Water from Wastes in Los Angeles Metropolitan Area", Bulletin No. 80.

Information on quality and quantity of waste water in Southern California is presented in annual reports currently entitled "Quantity, Quality, and Use of Waste Water in Southern California".

The investigation reported in this bulletin found that coastal San Diego County -- which is currently importing the major portion of its water supply -- is now discharging to the ocean in excess of 50 million gallons per day of waste water that could be reclaimed for certain beneficial uses. For certain of the projects described herein, costs of reclamation would be competitive with those of imported water. In a few cases, such reclamation already is being successfully carried out.

The Legislature has declared statewide interest in local development of waste water reclamation facilities by enacting the "Waste Water Reclamation and Reuse Law" to encourage full utilization of the water resources of the State.

This report is a final edition, published first as a preliminary edition. Agency and public hearings were conducted by the Department to obtain the opinions of all interested persons and agencies. This final edition reflects the testimony received. Comments received in the course of the hearings are on file in the Department's office in Los Angeles.

William R. Gianelli

William R. Gianelli, Director
Department of Water Resources
The Resources Agency
State of California
December 22, 1967

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State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

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WILLIAM M. CARAH
Executive Secretary

WILLIAM L. BERRY, SR.
Engineer

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

ENGINEERING CERTIFICATION

This report has been prepared under my direction as the professional engineer in direct responsible charge of the work, in accordance with the provisions of the Civil and Professional Engineers' Act of the State of California.

Registered Civil Engineer

Registration No. C 5592

Date 7/28/67

ATTEST:

District Engineer
Southern District

Registration No. C 6500

Date August 31, 1967

ACKNOWLEDGMENT

Contribution of information and data used in this investigation from various agencies located in the County of San Diego is gratefully acknowledged.

Special mention is made of the helpful cooperation of the following:

City of San Diego, Utilities Department

San Diego County Department of Special Services District

San Diego County Water Authority

San Diego Regional Water Quality Control Board

Santee County Water District

AUTHORIZATION

Investigations of reclamation of water from sewage and industrial waste are authorized by Section 230 of the California Water Code, which reads as follows:

> "230. The department, either independently or in cooperation with any person or any county, State, Federal, or other agency, or upon the request of the State Water Resources Control Board, to the extent funds are allocated therefor, shall conduct surveys and investigations relating to the reclamation of water from sewage or industrial wastes for beneficial purposes, including but not limited to the determination of quantities of such water presently wasted, and possibilities of use of such water for recharge of underground storage or for agricultural or industrial uses; and shall report to the Legislature and to the appropriate regional water quality control board thereon, . . . "

This investigation was conducted and the report prepared pursuant to the foregoing authorization.

ABSTRACT

The Coastal San Diego County waste water reclamation study was undertaken to supply detailed information pertaining to the reclamation of water from wastes in that area. This information includes the quality of reclaimable water, beneficial uses of this reclaimed waste water, and cost of producing reclaimed water from wastes. The study was authorized under Section 230 of the California Water Code. / Four phases were undertaken in carrying out the investigation. These were: (1) an estimation of present and future water requirements; (2) a survey of waste water discharging agencies and the determination of the quantity and quality of waste water available for reclamation; (3) determination of the portion of water requirements that may be satisfied by reclaimed waste water; and (4) a study of plans and costs to implement the use of reclaimed water. / It was determined that in 1965-66, about 63 million gallons per day of waste water effluent in Coastal San Diego County, or 74 percent of the total effluent, were reclaimable for beneficial uses. A portion of this reclaimable waste water is already either directly or indirectly reclaimed, primarily for irrigation, recreational lakes, and ground water recharge. / Of the waste water that is rated as reclaimable for at least some beneficial use, approximately 50 million gallons per day were discharged to the ocean in 1965-66. This amounted to 70 percent of the total waste discharge to the ocean in San Diego County. Plans to use some of this waste water were considered for four sites -- the El Cajon-La Mesa, Mission Gorge, Rose Canyon, and Spring Valley areas. Costs of producing reclaimable water for irrigation or other uses at the plant site were estimated to vary from $4 to $51 per acre-foot.

CHAPTER I. INTRODUCTION

Although local water resources in Coastal San Diego County have been developed to a high degree, they have proved inadequate to meet the rapidly increasing demands for water. This has been emphasized in the past two decades by severe drought conditions which have plagued Southern California. The increasing demands for water have been met by importation of water from the Colorado River through facilities of the San Diego County Water Authority and The Metropolitan Water District of Southern California. The use of reclaimed water in this area should be considered as a means for supplementing imported and local supplies.

In 1949, the California Legislature, recognizing the importance of developing all existing and new sources of water throughout the State, added Section 230 to the California Water Code, authorizing the Department of Water Resources to investigate the reclamation of water from domestic or industrial wastes for beneficial purposes. Waste waters discharged to tidal waters are considered lost for further beneficial uses. Thus, the reclamation of such waters is considered a potential new source of supply and, in this respect, is included as part of The California Water Plan.

In fulfilling its role of implementing The California Water Plan, the Department considers all sources of water in scheduling and sizing water conservation and transportation facilities.

Objective of Investigation

The general objective of this study is to investigate the feasibility of increased reclamation of waste water through the determination of the quantity and cost of water than can be made available through waste water reclamation to meet future supplemental water requirements for beneficial uses in coastal San Diego County.

The specific objective is to develop information to facilitate formulation of plans by local agencies for waste water reclamation and beneficial reuse. The attainment of these objectives required the determination of the following:

1. Water requirements of the area and the need for a supplemental supply.
2. Quantity and quality of water than can be reclaimed from waste water.
3. Beneficial uses for reclaimed water.
4. Costs of reclaimed water compared to alternative supplies.

More detailed studies would be required to establish the economic justification for each reclamation system before commencing design and construction of specific reclamation projects.

Area of Investigation

The area of this investigation, coastal San Diego County, is shown on Plate 1.

Coastal San Diego County comprises approximately 2,950 square miles of land area, which drains from the crest of the Peninsular Mountains west to the Pacific Ocean. The principal streams that drain the study area are the Santa Margarita, San Luis Rey, San Dieguito, San Diego, Sweetwater, Otay, and Tia Juana Rivers.

Topographically, the study area consists of three belts, or zones, of land. The first, or coastal plain, zone includes gently rolling hills and coastal plains comprising a 10-mile wide strip along the Pacific Ocean.

The second, or foothill-valley, zone is characterized by narrow valleys enclosed by ranges of hills extending inland an additional 10 to 15 miles. The third, or mountain, zone includes the Peninsular Mountain Range, which rises gradually to a crest elevation of more than 6,000 feet, 40 to 60 miles inland.

The climate in coastal San Diego County is generally mild with relatively light precipitation, most of which is in the form of rainfall. Proceeding inland, as elevations increase, temperature variations become wider and precipitation becomes greater. Mean seasonal precipitation is approximately 10 inches near the coast and more than 40 inches at the highest elevations in the Peninsular Mountain Range. Precipitation occurs principally in the winter, with about 90 percent of the seasonal total generally occurring from November through April.

The main crops are avocados, citrus fruits, and truck crops. If the urban development in San Diego County follows that of Los Angeles and Orange Counties, the eventual decline of irrigated agriculture may be expected.

The principal city in the County is San Diego, a major west coast city of approximately 680,000 persons. Its location makes it a gateway to Mexico for the large numbers of tourists who visit the area each year. A number of smaller cities and towns also occupy the study area, the largest of which border the City of San Diego.

The Eleventh Naval District has its headquarters in the City of San Diego, together with the attendant operational, training, and supply facilities. Camp Pendleton, a U. S. Marine Corps training camp, occupies a large area of the north coastal area near Oceanside.

Aircraft, electronic, aerospace, and light manufacturing industries are concentrated in and around the San Diego metropolitan area.

Retirement communities and recreational facilities such as golf courses, beaches, and park areas abound in the study area.

Conduct of Investigation

This investigation was completed in four phases. The initial phase consisted of a determination of present and future water requirements. The second phase was a survey of waste water discharging agencies in the study area and the determination of the quantity and quality of waste water available for reclamation. During the third phase, the portion of the demand for supplemental water that could be supplied by reclaimed waste water was determined. In the final phase, plans and cost estimates were developed to implement the use of waste water supplies. Locations for potential waste water reclamation plants were selected on the basis of an adequate supply of reclaimable water and an adequate demand for this water. Finally, capital costs for the selected reclamation plants were derived.

To facilitate the investigation of the study area, coastal San Diego County was divided into three subareas. The three subareas are the San Diego metropolitan subarea, the San Diego County subarea, and the Camp Pendleton subarea. They are shown on Plate 1.

In carrying out the investigation, data were collected from local, state, and federal agencies throughout coastal San Diego County. This entailed collecting samples of waste discharges and interviewing representatives of each of the discharging agencies, the Chambers of Commerce in the various municipalities, and the San Diego Regional Water Quality Control Board, San Diego County Water Authority, and other groups interested in waste water reclamation. In addition, a study was made of the literature pertaining to waste water reclamation and to coastal San Diego County.

Also, department records on ground water, surface water, land use, and other conditions in the study area were reviewed.

Prior Investigations and Reports

Published reports of reclamation of waste water conducted within coastal San Diego County area are:

Boyle Engineering, Consulting Engineers. "City of San Diego Water Reclamation Study for Balboa Park and Mission Bay Park". March 1963.

California Department of Public Works, Division of Water Resources. "Reclamation of Water from Sewage or Industrial Waste". December 1952.

----."Reclamation of Water from Sewage or Industrial Waste". June 1954.

California Department of Water Resources. "Reclamation of Water from Sewage and Industrial Wastes, July 1, 1953 - June 30, 1955". Bulletin No. 68. January 1958.

----."Reclamation of Water from Sewage and Industrial Wastes in California, July 1, 1955 - June 30, 1962". Bulletin No. 68-62. October 1963.

----."Quantity, Quality, and Use of Waste Water in Southern California, 1962-63". December 1965.

----."Quantity, Quality, and Use of Waste Water in Southern California, 1963-64". April 1966.

----."Quantity, Quality, and Use of Waste Water in Southern California, 1964-65". January 1967.

----."Quantity, Quality, and Use of Waste Water in Southern California, 1965-66". (In preparation)

Engineering-Science, Inc. "Engineering Report for the Santee County Water District on Water Reclamation System Expansion". June 1965.

Holmes and Narver-Montgomery. "Basic Plan for the Collection, Treatment and Disposal of Sewage for the Metropolitan Area, San Diego, California". November 1958.

Rawn, A M; McKee, Jack; and Vincenz, Jean L. "North Coastal San Diego County Sewerage Survey". June 1960.

Rawn, A M; Caldwell, David H.; and Hyde, Charles Gilman. "Report on the Collection, Treatment and Disposal of the Sewage of San Diego County, California". September 1952.

San Diego County, Department of Public Works. "Annual Report of the County Sanitation Districts, Fiscal Year 1961-62".

Short, Donald R. and Associates. "Sewage Feasibility Report for the Annexation Lands in the Vicinity of Lake Hodges - City of Escondido". March 1966.

----."Greater Jamacha Valley Sewage Water Reclamation Plan". May 1966.

CHAPTER II. WATER REQUIREMENTS AND SUPPLY

Early in the nineteenth century, the mission fathers built the first masonry dam in Mission Gorge to conserve water for irrigation of valley lands surrounding the San Diego Mission. Since then, local water sources in coastal San Diego County have been used extensively and are approaching ultimate development. A major source since 1947 has been the Colorado River, now supplying approximately 80 to 90 percent of the total demand.

Several factors have contributed to the increased dependence on imported water. The most critical factor has been the population growth in San Diego County. Another major factor has been the depletion of ground waters in coastal areas to supply the increased demand. The County has recently suffered the longest dry spell in history. This lack of precipitation has resulted in greatly reduced runoff; many reservoirs designed to impound water for public supply have been dry or nearly dry for several years.

Additional sources of water being developed to meet the increasing demand include waste water reclamation* and sea-water conversion[(29)**]. These efforts will probably be accelerated in the near future.

To give an idea of water conditions and the potential of waste water reclamation in San Diego County, this chapter first explores the water requirements -- both present and future -- and then compares these demands with the local supply and the availability and probable costs of imported supplies.

---

*Definitions of words used in this report are given in Appendix B.
**Numbers in parentheses indicate references listed in Appendix A.

Water Requirements

Water is required for the following beneficial uses in the study area: domestic consumption; commercial use; industrial use; irrigation of agricultural lands, parks, golf courses, and freeway green belts; and ground water replenishment.* The estimated total water requirements in the study area up to the year 2000 are presented in Figure 1.

Urban Water Requirements

The population of San Diego County has increased nearly five-fold since 1930. This population growth is reflected in the increased industrial activity and agricultural production, and the development of residential and retirement communities. Historical and projected population figures for San Diego County and the subareas are presented in Table 1.

TABLE 1

HISTORICAL AND PROJECTED POPULATION OF SAN DIEGO COUNTY AND SUBAREAS

Year	San Diego County	San Diego metropolitan subarea	San Diego County subarea[a]	Study Area Coastal San Diego
1930[b]	209,659	168,153	41,306	209,459
1940	289,348	241,346	47,702	289,048
1950	556,808	432,975	122,933	555,908
1960	1,033,011	806,437	225,437	1,031,511
1970	1,390,000	1,137,000	250,000	1,387,000
1980	1,800,000	1,495,000	300,000	1,795,000
1990	2,150,000	1,716,000	425,000	2,141,000
2000	2,450,000	1,925,000	509,000	2,434,000

a. Camp Pendleton subarea included. The population of Camp Pendleton was estimated to be 40,000 from 1960 to 2000(8).

b. 1930-1960 populations obtained from U. S. Department of Commerce, Bureau of Census(28).

*Underground storage by artificial recharge is a beneficial use if the water is later used.

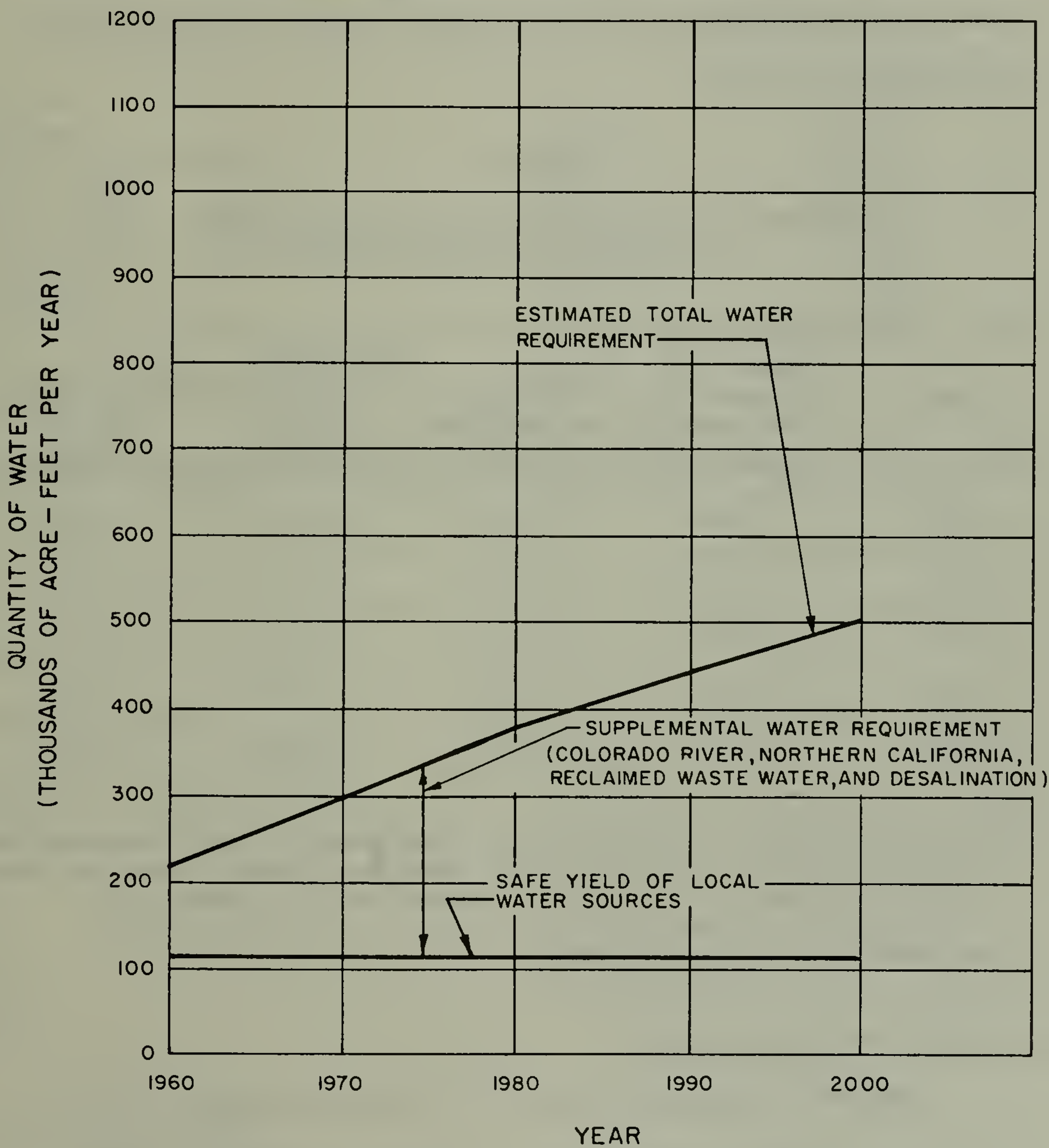


Figure 1 - FUTURE WATER REQUIREMENTS AND SUPPLY

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1967

Urban water requirements from the year 1960 to the year 2000 are given in Table 2. By the year 2000, it is expected that the urban water requirements will be 414,000 acre-feet per year. This is derived from the estimated population of 2,434,000 and a unit use of 0.170 acre-foot per capita per year.

TABLE 2

PRESENT AND PROJECTED URBAN WATER REQUIREMENTS
IN COASTAL SAN DIEGO COUNTY

Year	Unit urban water use, in acre-feet per capita per year[a]	Acre-feet		
		San Diego metropolitan subarea	San Diego County subarea[b]	Study area Coastal San Diego
1960	0.122	98,385	27,459	125,844
1970	0.150	171,000	38,000	209,000
1980	0.159	238,000	48,000	286,000
1990	0.166	285,000	71,000	356,000
2000	0.170	327,000	87,000	414,000

a. From a Department of Water Resources' memorandum report, "Statement On The Derivation of Future Values of Unit Urban Water Use and Net Urban Water Requirements for the South Coastal Area", December 1966.

b. Camp Pendleton subarea included.

Agricultural Water Requirements

Irrigated agricultural land in 1958 was approximately 63,425 acres. The corresponding agricultural water use was 95,327 acre-feet. Water requirements and acreage for various types of agriculture are presented in Table 3.

TABLE 3

AGRICULTURAL LAND AND WATER USE IN
COASTAL SAN DIEGO COUNTY IN 1958*

Crop	Acres	Applied water, in acre-feet per year
Alfalfa	2,690	6,456
Pasture	8,530	20,472
Citrus and subtropical	31,480	44,072
Truck crops	11,430	16,002
Field crops	1,030	1,442
Deciduous fruits and nuts	1,800	3,240
Small grains	5,710	2,284
Vineyards	755	1,359
TOTAL IRRIGATED AGRICULTURE	63,425	95,327

*Adapted from Department of Water Resources Bulletin No. 102, "San Diego County Land and Water Use Survey, 1958", Tables 4 and 5, page 30.

Water requirements of irrigated agriculture in coastal San Diego County from 1970 to 2000 are estimated by the Department of Water Resources to remain constant at about 90,000 acre-feet per year to the year 2000. Therefore, approximately 16 percent of the total water required in the year 2000 will be used for irrigated agriculture.

Water Supply

To meet present and future water requirements, a variety of sources have been or will be tapped. The following information on these water sources has been divided into present supply and future supply.

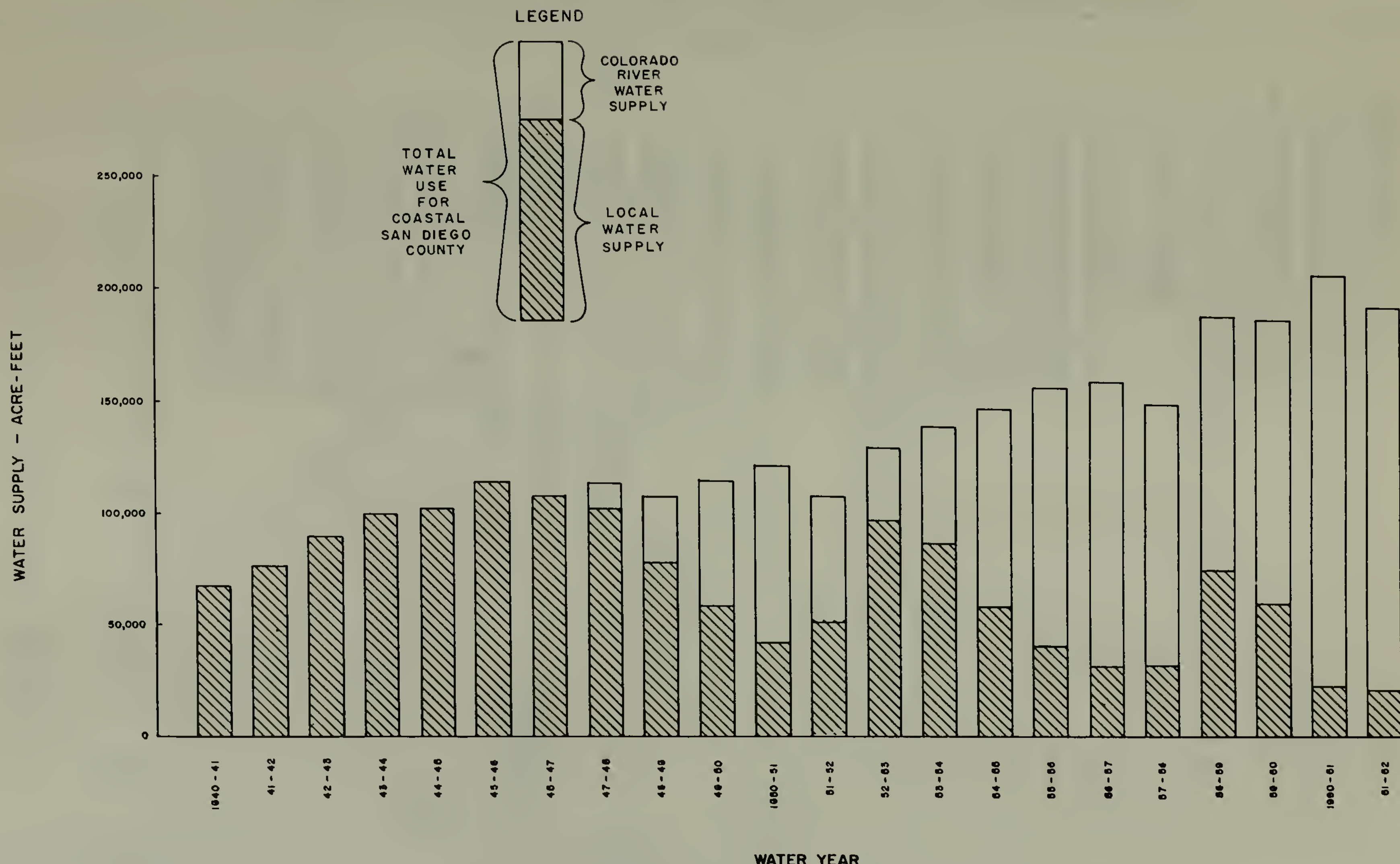
Present Water Supply

The present water supply of coastal San Diego County is derived from the following sources: Colorado River, surface storage, ground water basins, waste water reclamation. A sea-water conversion plant was operated at Point Loma until it was moved to Cuba in 1964, and a plant now under construction at Chula Vista is scheduled to be completed in 1967. The major water supply facilities in the study area are indicated on Plate 1.

Colorado River Water. The San Diego County Water Authority, a member agency of The Metropolitan Water District of Southern California, was organized in 1944 primarily for importing Colorado River water to San Diego County[24]. Authority membership consists of eleven municipal water districts, four irrigation districts, five cities, and one public utility district. The Water Authority service area includes about 94 percent of the population and approximately 25 percent of the area of San Diego County. Member agencies supply an estimated 97 percent of the total water demand in San Diego County, of which approximately 87 percent is derived from the Colorado River. Historical quantities of water supplied to the study area are presented on Figures 2 through 4.

Surface Water. The safe yield of surface storage developments is estimated to be about 66,000 acre-feet per year[9]. However, several factors have combined to reduce the actual yield in recent years. Current drought conditions, coupled with unprecedented increases in water demand, have necessitated overdraft of surface reservoirs, and the safe yield cannot presently be met.

Ground Water. The safe yield of presently developed ground water storage capacity is estimated to be 45,000 acre-feet per year[9]. Ground water basin levels have been lowered in recent years due to drought



NOTE: CAMP PENDLETON SUBAREA NOT INCLUDED

Figure 2 - HISTORICAL WATER PRODUCTION WITHIN MEMBER AGENCIES OF THE SAN DIEGO COUNTY WATER AUTHORITY IN COASTAL SAN DIEGO COUNTY

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1967

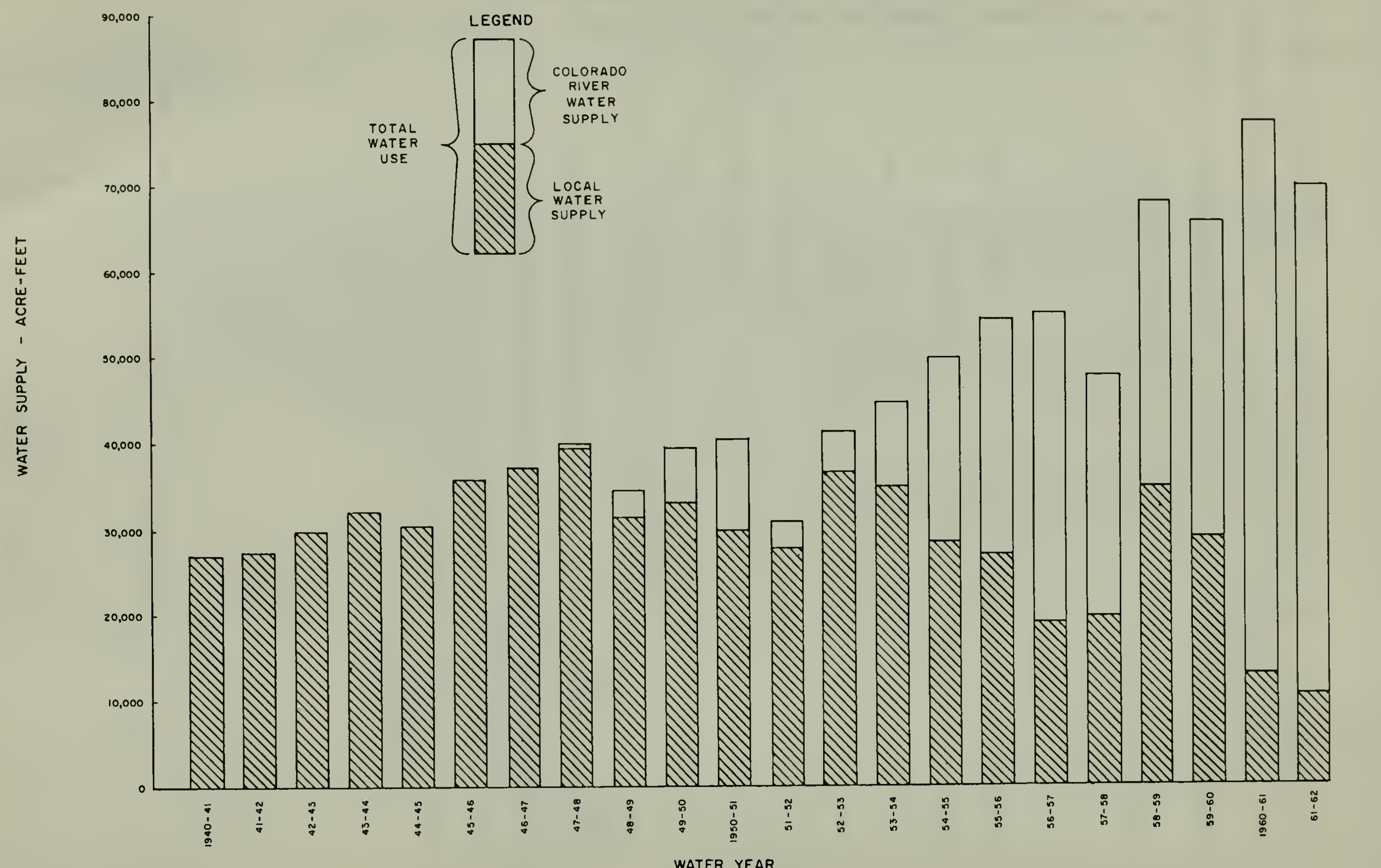


Figure 3 - HISTORICAL WATER PRODUCTION WITHIN MEMBER AGENCIES OF THE SAN DIEGO COUNTY WATER AUTHORITY IN SAN DIEGO COUNTY SUBAREA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1967

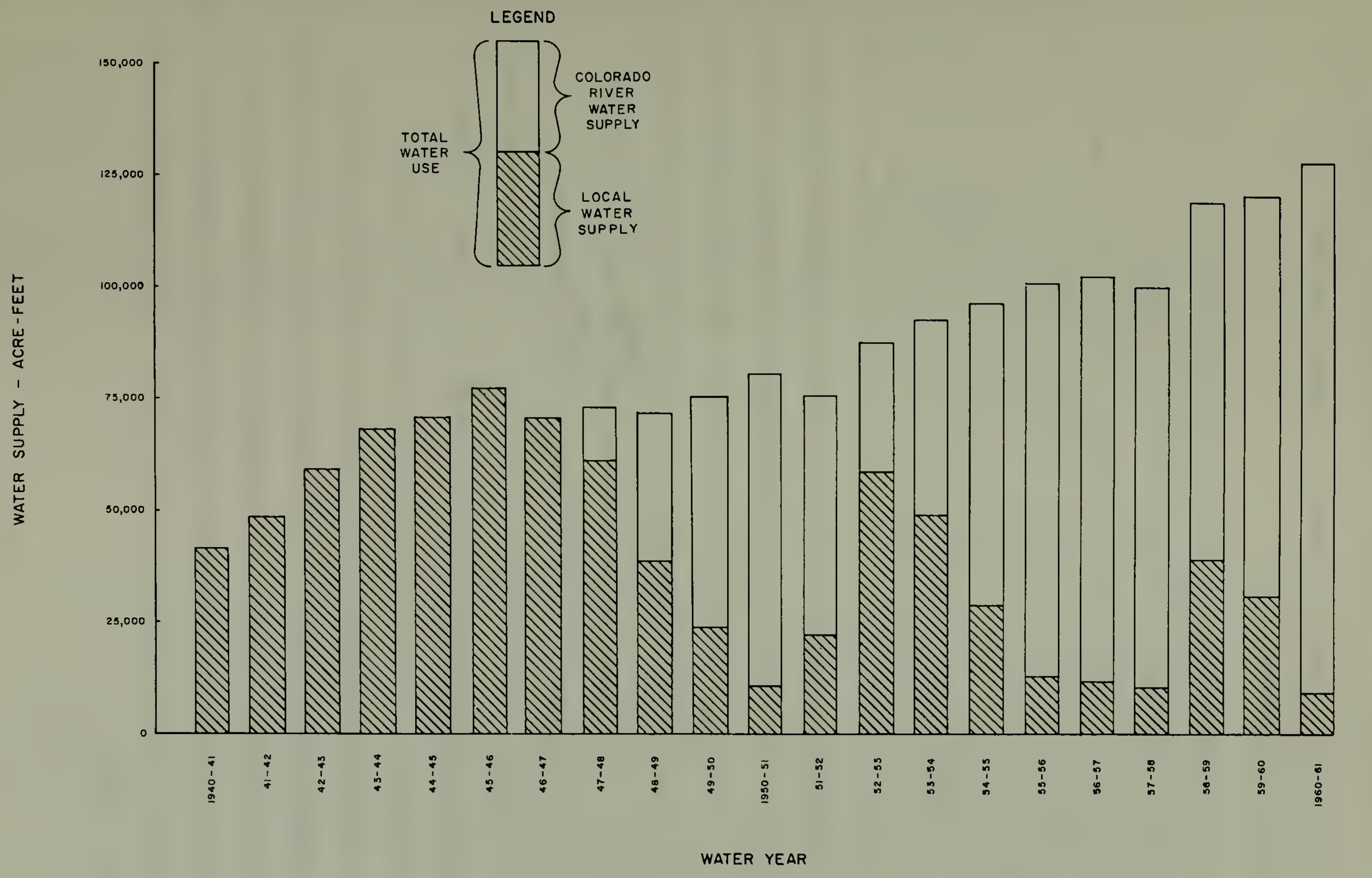


Figure 4 - HISTORICAL WATER PRODUCTION WITHIN MEMBER AGENCIES OF THE SAN DIEGO COUNTY WATER AUTHORITY IN SAN DIEGO METROPOLITAN SUBAREA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1967

conditions and overdraft. In addition, sea-water intrusion and other forms of pollution have degraded some of the ground water bodies, rendering them unsuitable for domestic use.

<u>Waste Water Reclamation</u>. Reclaimed water is derived from waste water resulting from domestic and industrial use. Reclaimed water can be used for purposes such as irrigation, thereby releasing water of better quality for domestic consumption. About 18,000 acre-feet per year of waste waters are presently being reclaimed for irrigation, ground water recharge, and decorative and recreational lakes in the study area. This subject will be discussed in greater detail in subsequent chapters.

<u>Sea-Water Conversion</u>. In 1958, the U. S. Congress authorized the Department of the Interior to construct and operate an experimental saline water conversion plant on Point Loma in the City of San Diego. The Department of Water Resources cooperated in this enterprise and contributed more than $800,000, or half the construction costs. This was a 1,000,000-gallon per day multistage flash distillation plant that was placed in operation in November 1961. The plant was dismantled and erected in Cuba in 1964. Since that time, a new Second Generation Plant was authorized for construction to replace the Point Loma Plant in Chula Vista. The "Senator Clair Engle Desalting Plant", designed for a maximum 1,000,000-gallon per day capacity, is scheduled to begin operation in 1967. Transmission facilities were financed and constructed by the Department of Water Resources. A second installation to test full scale plant modules which are parts of larger saline conversion plants will begin test operations in 1968.

Future Water Supply

The future water supply for coastal San Diego County will come from the following sources: the Colorado River, Northern California water, local surface water, local ground water, waste water reclamation, and sea-water conversion. Local and Colorado River water sources have been developed to near ultimate capacity. The need for supplemental water to meet future increases in demand in San Diego County and elsewhere in the State has brought about the development of The California Water Plan and authorization and construction of the State Water Project. Present plans call for the delivery of Northern California water through the state facilities to Perris reservoir in Riverside County, and thence through facilities of The Metropolitan Water District of Southern California and the San Diego County Water Authority to the study area by 1972. At present, the major source of supply to the City of San Diego is Colorado River water conveyed through the facilities of the San Diego County Water Authority's two aqueducts. The City of San Diego pays approximately $50 per acre-foot for Colorado River water, including payment of taxes to The Metropolitan Water District of Southern California. In the San Diego Metropolitan area, consumer costs for water vary from about $90 to about $150 per acre-foot.

A portion of this future water demand could be supplied at a lower cost through the use of reclaimed water. The remaining sections of this report are devoted to the discussion of waste water reclamation with respect to quantities of reclaimable wastes; quality of waste flows; and plans, including costs, for the use of reclaimed waste water for lower priority beneficial uses.

CHAPTER III. WASTE WATER QUANTITIES

The total waste water flow in coastal San Diego County in the 1965-66 fiscal year was about 86 million gallons per day (mgd). Of this, approximately 85 percent (72 mgd) was discharged to the ocean in 1965-66. A major contributor to this figure is the San Diego metropolitan subarea, which discharged in 1965-66 about 70.5 mgd of its waste waters to the ocean.

During 1962-63, waste water in the study area consisted of about 72 gallons per capita per day, or approximately 66 percent of the total domestic and industrial water supply. Waste water contributions for coastal San Diego County and the City of San Diego are presented in Figure 5. These contributions were calculated by dividing the waste water flow by the population served by sewerage systems. Waste water flows were taken from flow records obtained from the various waste disposal agencies. In San Diego it is assumed that the entire population is served by sewerage systems. Approximately 90 percent of the population in 1962-63 in the coastal county area was served by sewerage systems.

In this report, waste discharge quantities are discussed under the three subareas: the San Diego metropolitan subarea, the San Diego County subarea, and the Camp Pendleton subarea. Waste water treatment facilities, except for the Point Loma plant, are discussed in Appendix C and are indicated on Plates 2A and 2B. Historical discharge quantities of waste water are tabulated in Appendix D.

San Diego Metropolitan Subarea

Disposal of liquid wastes became a function of the City of San Diego in 1885 when the first sewers were built. However, San Diego's

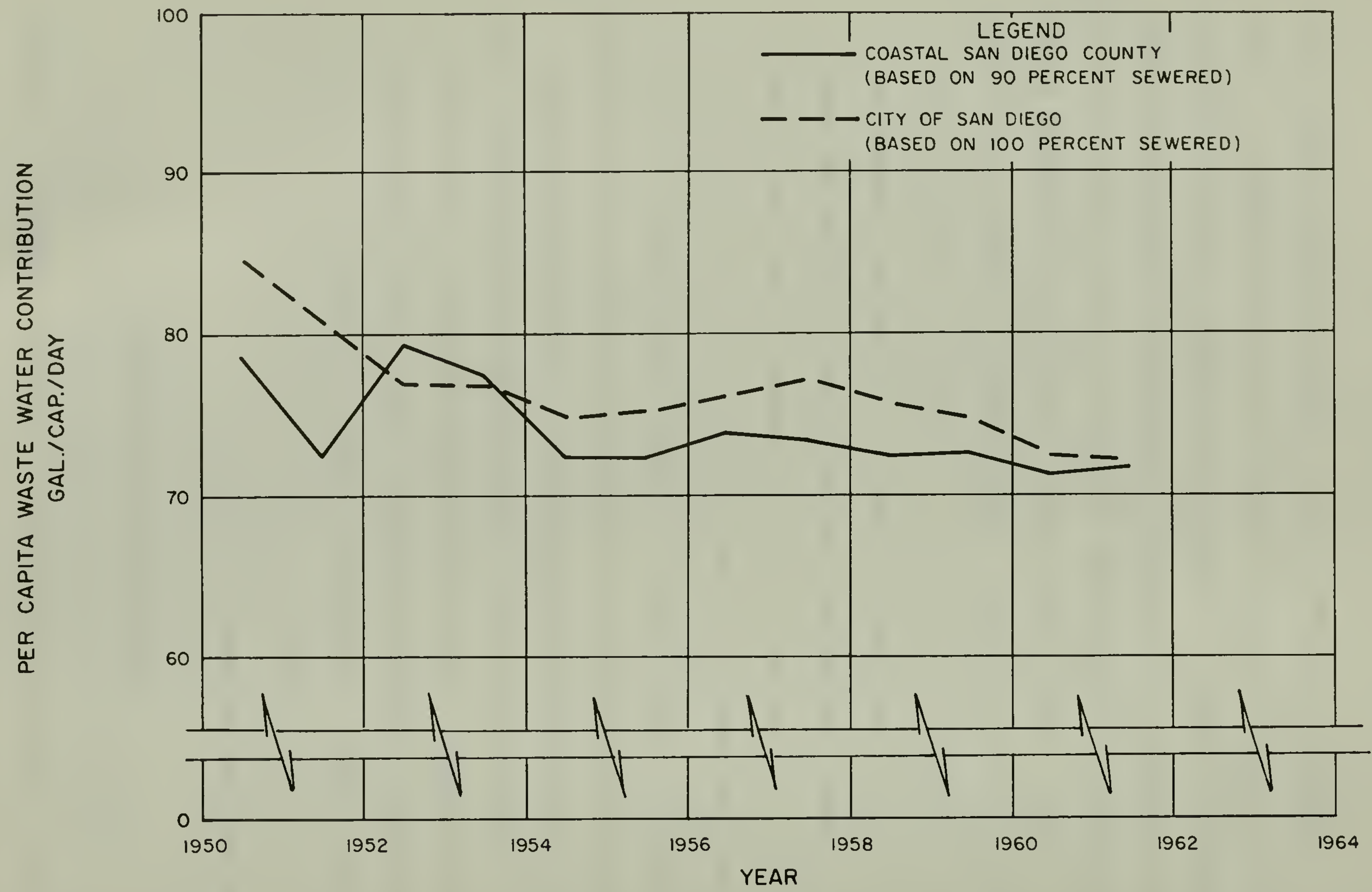


Figure 5 - PER CAPITA WASTE WATER CONTRIBUTION IN COASTAL SAN DIEGO COUNTY

first sewage treatment facility, a 14 mgd treatment plant on Harbor Drive, was put into operation in 1943. In 1948-49, it was enlarged to 40 mgd.

During this period, sewage treatment plants were developed in many surrounding communities to handle increasing waste water flows. Because of the continued explosive growth of the San Diego area, the treatment plants became overloaded. Contamination of San Diego Bay from the many discharge outfalls brought a quarantine of a section of the Bay by the State Department of Public Health in 1955.

In 1958, the city council retained engineering services for the design of a sewage collection, treatment, and disposal system for the San Diego metropolitan subarea. At this time, most of the surrounding communities, which had separate treatment facilities, decided that joining a Metropolitan Sewerage System with unified control would be the most economical method of eliminating contamination of San Diego Bay and the shores of the Pacific Ocean. On completion of the new system, most of the major dischargers were incorporated into the Metropolitan Sewerage System. The other dischargers still in operation are those from the Lakeside Sewage Treatment Plant, Brown Field, Santee Sewage Treatment Plant and Ream Field. These plants are described in Appendix C.

The new San Diego Metropolitan Sewerage System, which incorporates most of the independent dischargers, now handles approximately 98 percent of the total flow produced in this subarea. The system is composed of a large network of collector and interceptor sewer lines with a single ocean outfall located on Point Loma.

The City of San Diego's Point Loma plant is a primary treatment facility with an ocean outfall. The plant treats and discharges the flow from the Metropolitan Sewerage System, which serves an area of 400 square miles. The plant has a design capacity of 88 mgd and in 1965-66 treated about 70.5 mgd. This plant consists of three mechanical bar screens, a raw sewage pumping station, two aerated grit removal tanks, four sedimentation tanks, two primary digesters, and two secondary digesters. The digested sludge is pumped to Mission Bay Park for landfill, and the plant effluent is discharged to the Pacific Ocean.

Some of the major interceptor, or trunk, sewers are listed in Table 20, Appendix D, along with the flow in mgd and acre-feet per year for each during selected flow periods. Annual reports by this Department on "Quantity, Quality and Use of Waste Water in Southern California" contain recent information on waste water in the study area. The locations of the trunk sewers and the sampling points are shown in Figure 6. In addition, this figure shows the locations of the pumping and metering stations for the San Diego Metropolitan Sewerage System.

The San Diego Metropolitan Sewerage System is designed to meet the needs to the year 2000, for an ultimate capacity of 234 mgd. Each participating agency has reserved a portion of this design capacity to the year 2000. A summary of the apportionments and percent of total capacity for each contributing agency are as shown in Table 4.

Costs to each participating agency for the disposal of sewage through the Metropolitan Sewerage System consist of a fixed charge for the capital cost of the system plus an operating charge based on the amount of sewage that each agency discharges into the system. Capital

Figure 6-SAN DIEGO METROPOLITAN SEWERAGE SYSTEM AND LOCATION OF SAMPLING POINTS

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1967

TABLE 4

APPORTIONMENT OF SAN DIEGO METROPOLITAN SEWERAGE SYSTEM(25)

Agency	Capacity service proportion	
	Apportionment in million gallons per day	Percent of design capacity
City of Chula Vista	22.2	9.5
City of Coronado	3.0	1.3
City of El Cajon	10.0	4.3
City of Imperial Beach	3.0	1.3
City of San Diego	168.7	72.1
Spring Valley Sanitation District	6.0	2.5
Other participating agencies	21.1	9.0
TOTAL	234.0	100.0

costs for the complete system will probably average about $25 per acre-foot of sewage discharged. The operating charge is in the range of $13 to $15 per acre-foot of sewage discharged.

The historical quantities of sewage discharged in the San Diego metropolitan subarea are listed in Table 21, Appendix D. The quantity of sewage discharged in the metropolitan subarea increased from more than 44 mgd in 1955-56 to more than 72 mgd in 1965-66. The City of San Diego, the principal contributor in this subarea, discharged 91 percent of the total sewage flow in 1955-56 and the Point Loma Plant contributed 98 percent of the total flow in 1965-66.

Variations in the quantities of sewage discharged by some of the sewage treatment plants in the metropolitan subarea during 1961-62 fiscal year are presented in Figures 7 and 8.

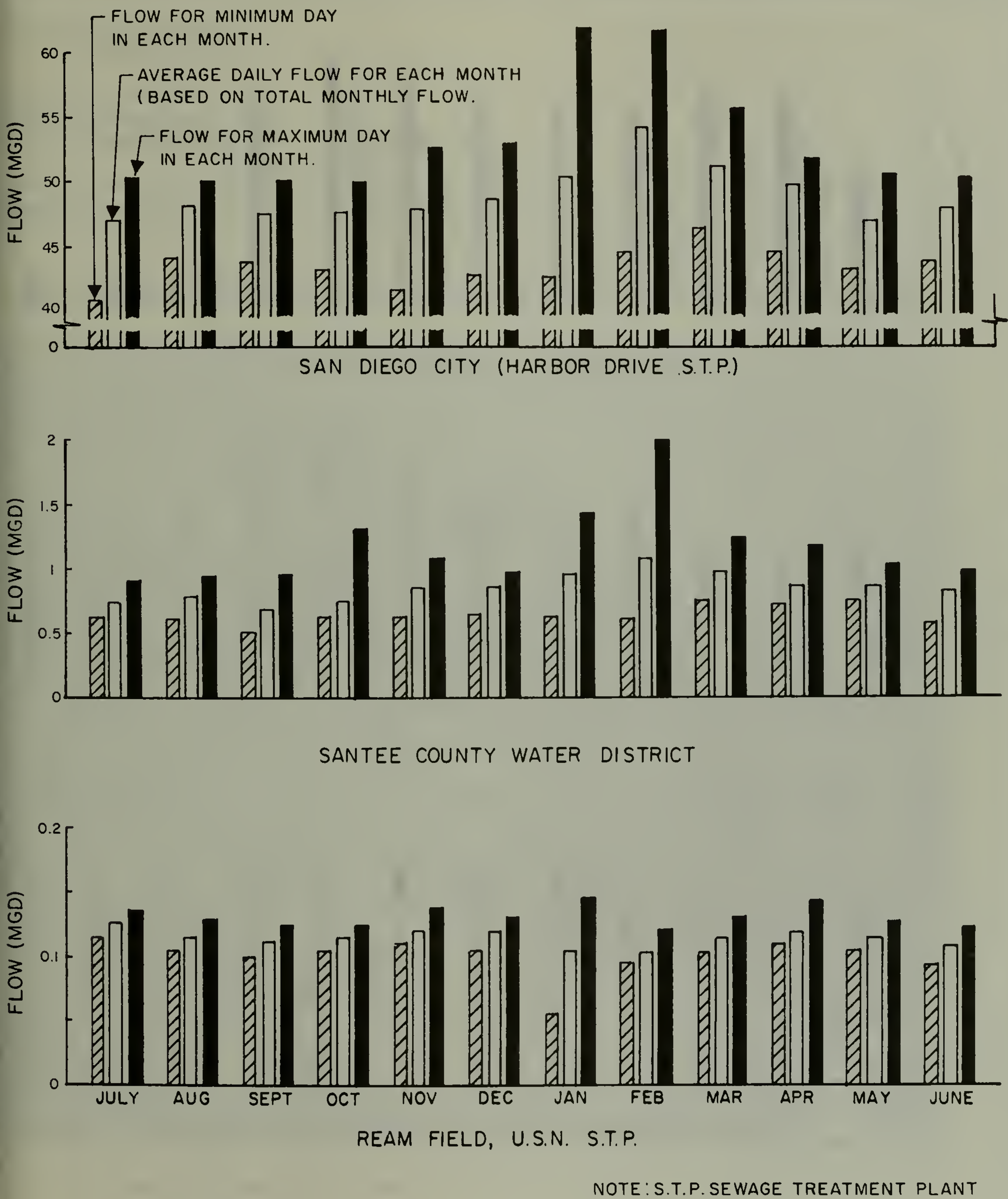
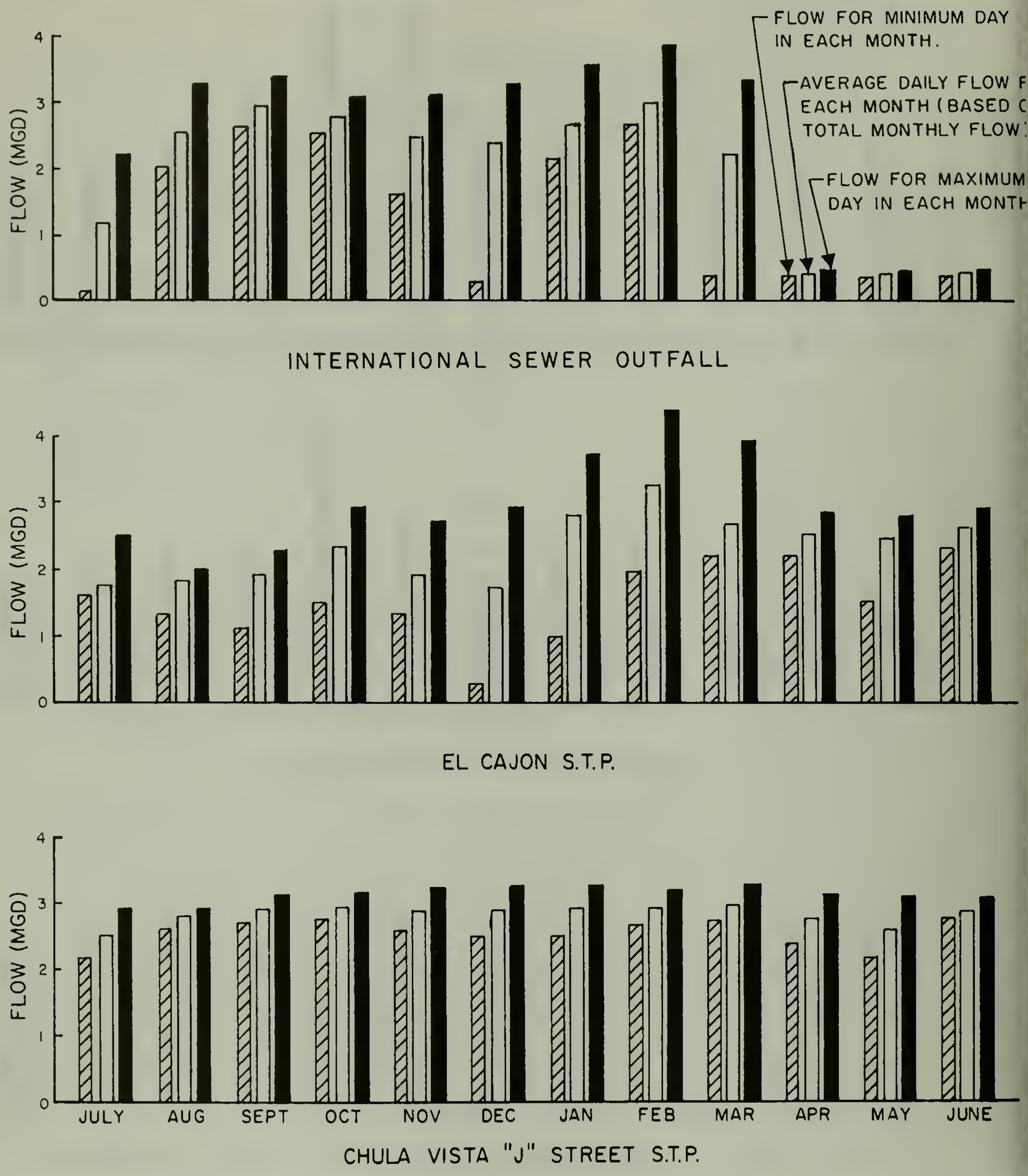


Figure 7-VARIATION OF MONTHLY DISCHARGES OF SEWAGE FROM THE SAN DIEGO METROPOLITAN SUBAREA DURING 1961 - 62



NOTE: S.T.P. SEWAGE TREAMENT PLANT

Figure 8-VARIATION OF MONTHLY DISCHARGES OF SEWAGE FROM THE SAN DIEGO METROPOLITAN SUBAREA DURING 1961 - 62

LOOKING SOUTH ALONG POINT LOMA

The pier used in constructing the ocean outfall from the Point Loma treatment plant may be seen in the upper right-hand corner.

From the Historical Collection of Title Insurance and Trust Company

San Diego County Subarea

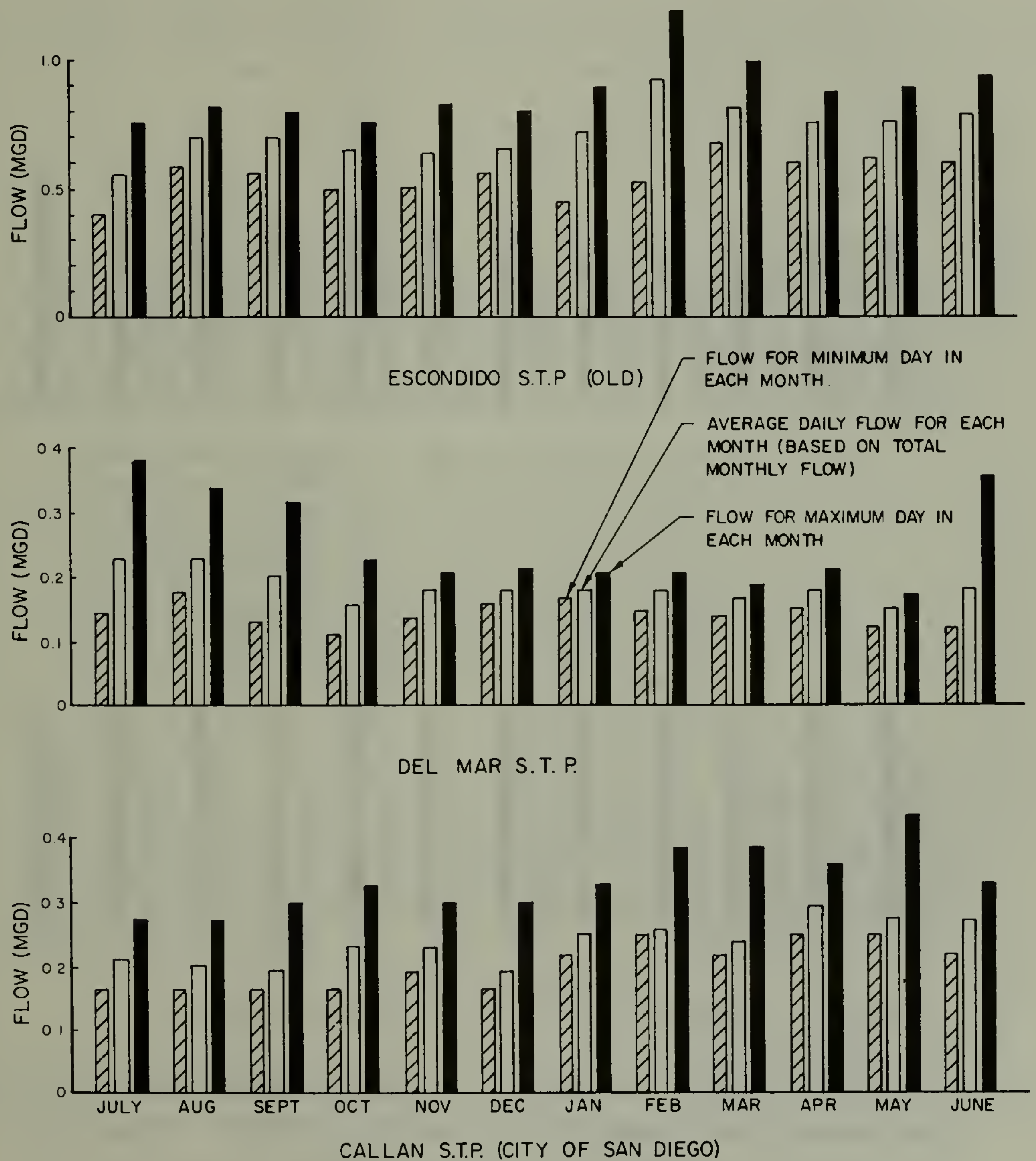
The San Diego County subarea consists of all of coastal San Diego County except the area contained in the metropolitan subarea, the military installations at Camp Pendleton, and the Fallbrook Naval Reservation. In the county subarea are 15 waste water treatment agencies, which operate 29 treatment plants, consisting of 2 primary treatment facilities and 27 secondary treatment facilities. Appendix C describes sewage plant facilities in the San Diego subarea.

The majority of the plants in the San Diego County subarea were built in the late 1940's under the County Sanitation District Act, and since that time have been greatly expanded. In the late 1940's and early 1950's, the majority of sewage discharges were insignificant, except for those from Oceanside and Escondido. Package type treatment plants have been built in the area since 1960. The quantities listed in Table 22, Appendix D, represent the average daily flow for the major discharges from the 1955-56 through the 1963-64 fiscal years. The total daily flow from the County subarea increased significantly from approximately 2.23 mgd in 1955-56 to approximately 10.1 mgd in 1965-66.

Variations in the quantities of sewage discharged in the County subarea during the 1961-62 fiscal year are presented in Figures 9 and 10. Minor variations in discharge occur at Oceanside and the new Escondido Treatment Plants. Major variations occurred at the Del Mar, Callan, and old Escondido Treatment Plants.

Camp Pendleton Subarea

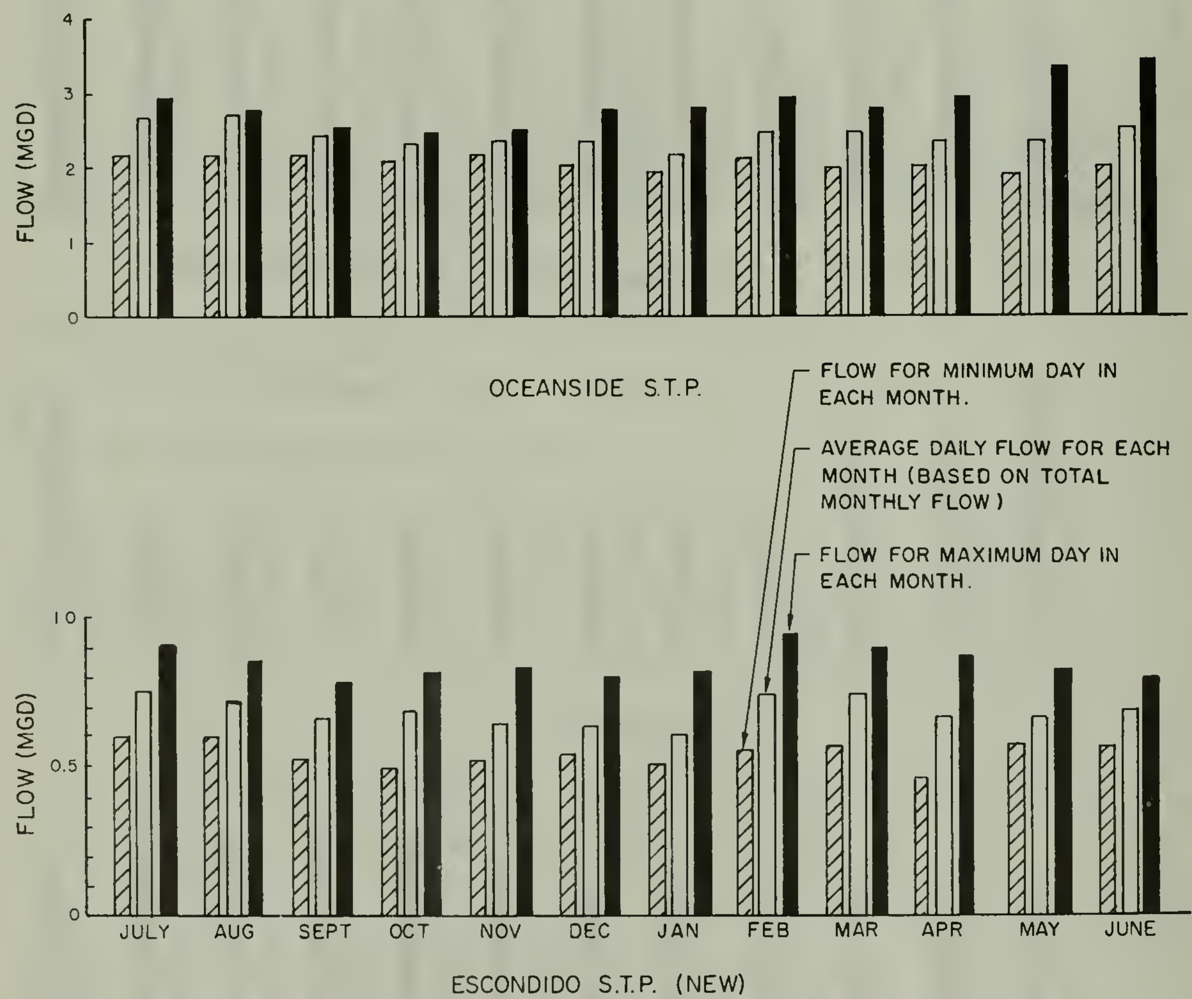
The Camp Pendleton subarea consists of two United States Naval establishments -- Camp Pendleton Marine Corps Base and Fallbrook Naval



NOTE: S.T.P. SEWAGE TREATMENT PLANT

Figure 9 - VARIATION OF MONTHLY DISCHARGES OF SEWAGE FROM THE SAN DIEGO COUNTY SUBAREA DURING 1961 - 62

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1967



NOTE: S.T.P. SEWAGE TREATMENT PLANT

Figure 10-VARIATION OF MONTHLY DISCHARGES OF SEWAGE FROM THE SAN DIEGO COUNTY SUBAREA DURING 1961 - 62

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1967

Ammunition Depot. Sewage treatment facilities in this subarea consist of twelve treatment plants; eleven serve Camp Pendleton, and one serves the Fallbrook Naval installation. Of the twelve treatment plants, nine provide secondary treatment, one provides primary treatment with chlorination, and two are waste water stabilization ponds. The plants are described in Appendix C.

The Camp Pendleton subarea has a total area of 135,775 acres and a population of 25,928 (1960 census). Annual discharge quantities for the 11 operating treatment plants serving Camp Pendleton and the period of record on each discharge are as follows:

Plant No. 1:	901 acre-feet	(10-year average)
Plant No. 2:	742 acre-feet	(10-year average)
Plant No. 3:	489 acre-feet	(18-year average)
Plant No. 8:	260 acre-feet	(8-year average)
Plant No. 9:	303 acre-feet	(9-year average)
Plant No. 10:	156 acre-feet	(8-year average)
Plant No. 11:	295 acre-feet	(9-year average)
Plant No. 12:	349 acre-feet	(7-year average)
Plant No. 13:	345 acre-feet	(8-year average)
Plant No. 14:	242 acre-feet	(2-year average)
Plant No. 15:		(Established December 1966)

Average daily flows from the 1955-56 through the 1963-64 fiscal years for the Camp Pendleton subarea are presented in Table 23, Appendix D. In 1959, Plants No. 4, 5, and 6 were abandoned and the flow incorporated and discharged through Plant No. 13.

Variations in the quantities of sewage discharged in the Camp Pendleton subarea during the 1961-62 fiscal year are presented in Figures 11 and 12. Minor variations occur at the Camp Pendleton Treatment Plants, and major variations occur at the Fallbrook Naval Reservation Treatment Plant.

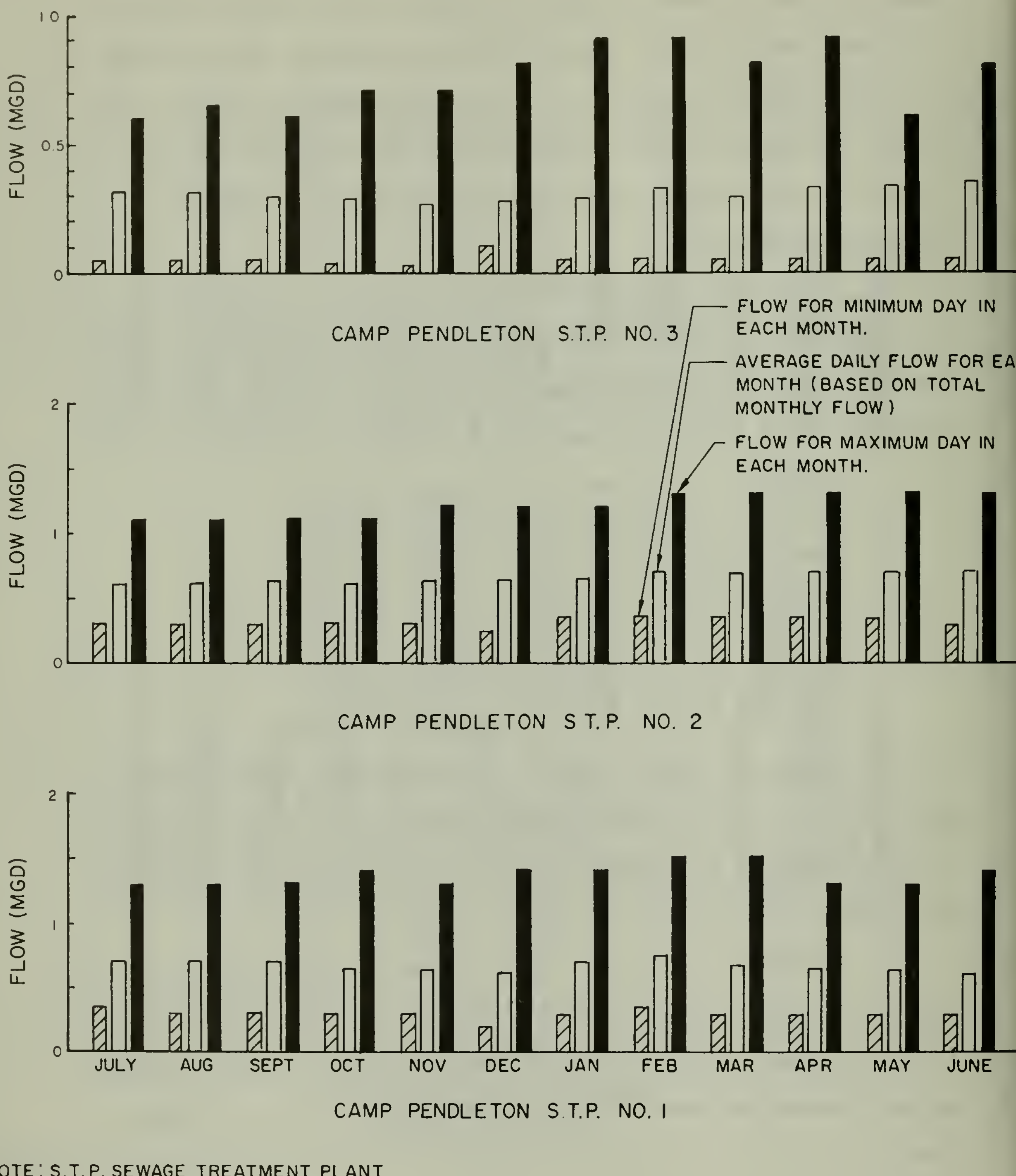


Figure 11-VARIATION OF MONTHLY DISCHARGES OF SEWAGE FROM THE CAMP PENDLETON SUBAREA DURING 1961 - 62

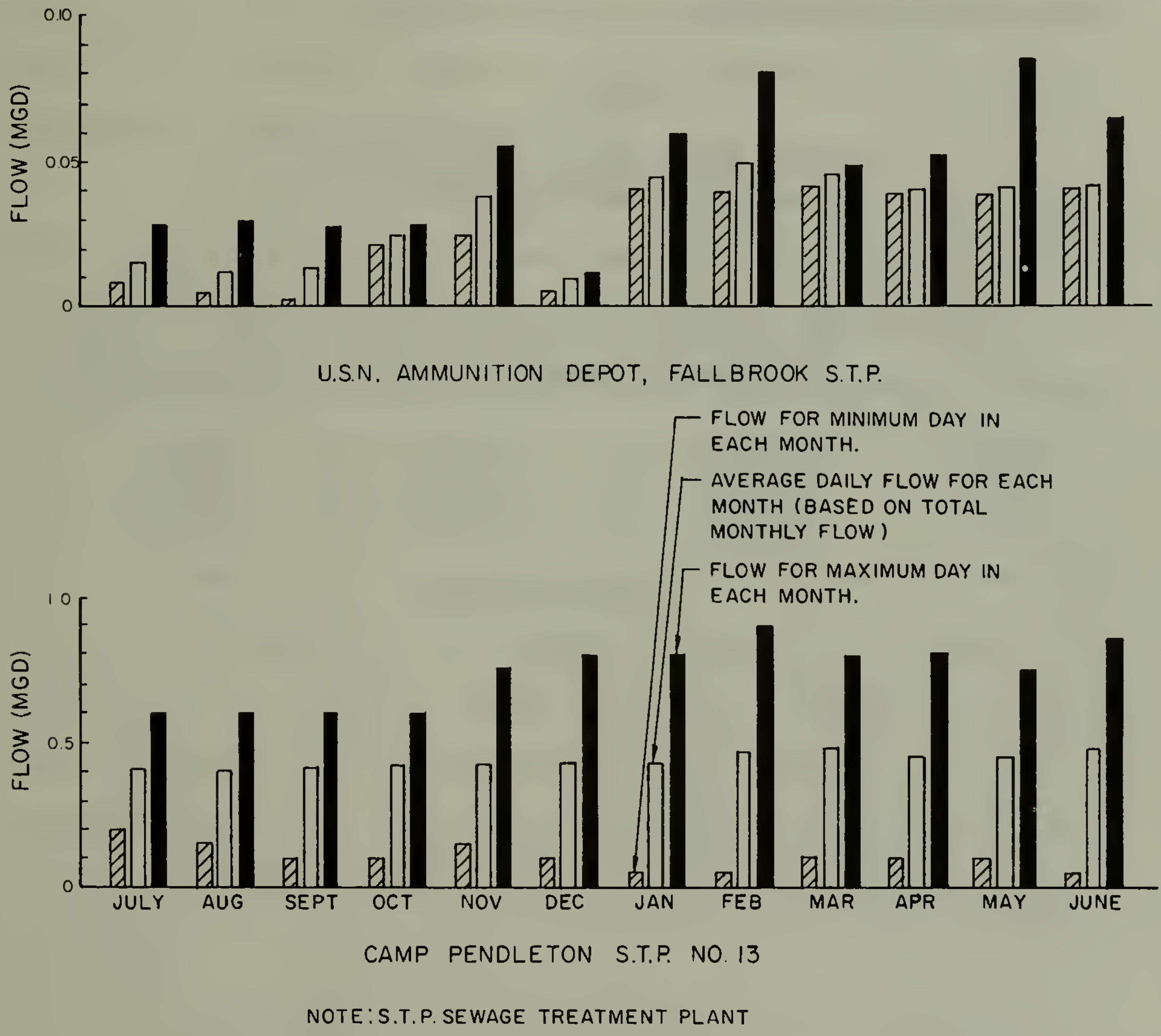


Figure 12-VARIATION OF MONTHLY DISCHARGES OF SEWAGE FROM THE CAMP PENDLETON SUBAREA DURING 1961-62

Future Quantities of Waste Water

On the basis of population estimates in Table 1 and 72 gallons per capita per day waste water contributions, estimated future waste water flows are given in Table 5.

TABLE 5

ESTIMATED FUTURE SEWAGE FLOWS PRODUCED
IN COASTAL SAN DIEGO COUNTY

In acre-feet

Year	Metropolitan subarea	County and Camp Pendleton subareas	Total for Coastal San Diego County
1970	82,000	18,000	100,000
1980	108,000	22,000	130,000
1990	124,000	31,000	155,000
2000	139,000	37,000	176,000

CHAPTER IV. QUALITY OF WASTE WATERS

Quality of water supplies and quality of waste water flows are interdependent. The most significant factor affecting quality of waste waters is the quality of the water supplied to consumers. In turn, the quality of a reclaimable water supply and the possible beneficial uses depend on the quality of waste water flow.

Other factors also influence the quality of waste water. This chapter presents the results of the investigation into the various factors affecting quality of waste discharges in coastal San Diego County, it enumerates the standards used to evaluate water quality (these are given in greater detail in Appendix E), and it determines the suitability of reclaiming waste waters for possible beneficial uses.

Quality Criteria

In evaluating the mineral quality of waste water to test its suitability for reclamation, the first consideration should be the potential use, because each use has its own criteria. Other factors to be considered include the relative quality and availability of other sources of water and, if the reclaimed water is used for ground water recharge, salt balance.

Although direct use of reclaimed water would be limited to a few selected markets, recharge of ground water basins with reclaimed water would bring about its indirect use where ground water is used. There fore, waste waters of only the best mineral quality available should be used for recharge of ground water basins.

Mineral Criteria

General mineral quality criteria for waste water for reclamation in the San Diego coastal area are presented in Table 6. This table was based on quality criteria used for waste water reclamation in the Los Angeles metropolitan area.[13]

TABLE 6

GUIDELINES FOR MINERAL QUALITY OF
WASTE WATER FOR RECLAMATION PURPOSES

Constituent	Limiting values, in parts per million		
	Suitable	Marginal	Unsuitable
Chlorides	Less than 200	200 to 500	More than 500
Chlorides plus sulfates	Less than 500	500 to 1,000	More than 1,000
Boron	Less than 1	1 to 2	More than 2
Total dissolved solids	Less than 1,000	1,000 to 2,000	More than 2,000

Waters classed as suitable can usually be reclaimed successfully for prevailing and anticipated beneficial uses. Waters classed as marginal may be reclaimed for many beneficial uses (irrigation of salt tolerant crops, recreation lakes, and certain industrial uses) but not for uses with the strictest quality requirements. Waters classed as unsuitable generally do not meet the requirements for normal beneficial uses. Should any one of the four constituents given in Table 6 fall in a less desirable class, the water is classified in the next lower class.

Legal Requirements

Consideration must always be given to regulations and requirements imposed on the reclamation of water from wastes by state and local authorities, the California State Department of Public Health, the State Water Quality Control Board, the Department of Fish and Game and the San Diego Regional Water Quality Control Board.

The California State Department of Public Health has the authority to abate contamination and has set standards for the use of waste water by the Health and Safety Code, Sections 5410 to 5413, which prohibits discharge of sewage effluent in any manner that will result in contamination or nuisance. Authority to issue requirements concerning pollution and nuisance resulting from sewage effluent discharge is vested in the regional water quality control boards by Water Code Section 13053.

Factors Affecting Mineral Quality of Waste Waters

Waste water flows in the study area generally consist of three components: domestic wastes, industrial wastes, and infiltration water. The major factors that affect the quality of a waste water are: the mineral quality of the water supply, the mineral pickup resulting from domestic and industrial use, and the quantity and quality of the infiltration water.

Mineral Quality of Water Supplies

The most significant factor affecting the mineral quality of a waste water is the quality of the original water supply. However, because of the addition of minerals through domestic and industrial use, the mineral content of a waste water is invariably higher than the mineral content of the original supply. Conventional waste treatments do not appreciably affect this mineral quality. Thus, upgrading or downgrading the mineral quality of the water supply will correspondingly upgrade or downgrade the mineral quality of the resulting waste water.

Water is supplied to coastal San Diego County from the Colorado River and local water supplies. Local water supplies consist of surface water from surface reservoirs, ground waters, and reclaimed waste water. Since the use of Colorado River water began in 1947, San Diego County has become increasingly dependent on this source. About 90 percent of the water used in the County is Colorado River water. Thus, the quality of the San Diego County water supply and the resulting waste water will be influenced primarily by the mineral quality of Colorado River water and importations from Northern California, with varying minor influences from the local supplies.

The overall quality of all water supplied to coastal San Diego County lies on the borderline between class 1 and class 2 irrigation waters. Domestic waters may be classified as "very hard" in average quality. Total dissolved solids content varies from less than 100 ppm in well water supplies near the Sutherland Reservoir, approximately 35 miles northeast of the City of San Diego, to several thousand ppm in sea-water intruded ground waters near the coast.

Colorado River Supply. Colorado River water may be classed domestically as "very hard" and agriculturally between class 1 and class 2 irrigation water. Mineral analyses of Colorado River water delivered to the Los Angeles metropolitan area from 1945 through 1960 are shown in Table 7.

TABLE 7

MINERAL ANALYSES OF COLORADO RIVER WATER
DELIVERED TO LOS ANGELES METROPOLITAN AREA
FROM 1945 THROUGH 1960

(Average for years 1945 through 1960)

Period	Concentration of mineral constituents, in parts per million		
	Chloride	Sulfate	Total dissolved solids
1945-46	92	345	757
1946-47	91	333	737
1947-48	90	325	728
1948-49	85	314	701
1949-50	79	295	666
1950-51	79	290	661
1951-52	80	286	652
1952-53	77	277	631
1953-54	75	276	632
1954-55	81	292	669
1955-56	98	342	766
1956-57	109	364	815
1957-58	100	323	738
1958-59	72	269	617
1959-60	74	263	609
AVERAGE	85	306	692

Note: Samples taken from the F. E. Weymouth Softening and Filtration Plant at La Verne.

Average values for these analyses are: Total dissolved solids, 692 ppm; sulfates, 306 ppm; and chlorides, 85 ppm. Mineral analyses of Colorado River water samples taken from the San Diego County aqueducts in 1962 are presented in Table 8. The average values are: Total dissolved solids, 767 ppm; sulfates, 302 ppm; and chlorides, 95 ppm. Because the concentration of boron was not reported, the concentration was assumed to be similar to that reported for the river water

TABLE 8

MINERAL ANALYSES OF WATER SAMPLES TAKEN FROM
COLORADO RIVER AQUEDUCTS, BARRETT LAKE,
EL CAPITAN RESERVOIR, AND
SUTHERLAND RESERVOIR IN SAN DIEGO COUNTY DURING 1962

Constituents*	Colorado River Aqueducts**	Barrett Lake	El Capitan Reservoir	Sutherland Reservoir
pH	8.1	8.4	8.0	8.8
Electrical conductance	1,149	980	634	518
Calcium	84	40	46	30
Magnesium	32	36	22	18
Sodium	105	109	50	46
Potassium	5	9	6	12
Carbonate	0	4	0	11
Bicarbonate	143	291	186	138
Sulfate	302	68	87	52
Chloride	95	118	54	50
Nitrate	2.4	0.6	1	0.3
Fluoride	0.4	0.4	0.2	0.2
Silica	13	7	23	6
Total dissolved solids	767	578	386	303
Total hardness as $CaCO_3$	340	244	207	146
Percent sodium	40	50	34	40

*All chemical constituents are in ppm except pH, electrical conductance, and percent sodium. Electrical conductance is in micromhos per cm. at 25° C.

**Analyses for samples collected at west portal of San Jacinto Tunnel.

delivered to the Los Angeles area. These analyses indicate sulfate and total dissolved solids contents greater than the United States Public Health Service Drinking Water Standards recommended concentrations of 250 ppm and 500 ppm, respectively.

Ground Water Supplies. The San Diego County ground water supplies come from a number of wells and springs which deliver water from underground basins. From these, 17 wells were selected as yielding water representative in quality of the overall ground water supply in the study area. Of the 17 wells, 7 are in the metropolitan subarea and 10 are in the county subarea. Well locations are shown on Plate 1. The ground water supply may be classed as "very hard" for domestic use and from class 2 to class 3 irrigation water for agricultural use. In general, the ground waters in the study area are poorly suited for domestic consumption.

San Diego Metropolitan Subarea. Mineral analyses of samples obtained from the wells in the San Diego metropolitan subarea during 1962 are presented in Table 9. The total dissolved solids content varied from 850 to 1,932 ppm, electrical conductance ranged from 1,560 to 3,150 micromhos per centimeter, and chloride content varied from 287 to 667 ppm. Based on the above results, the well waters in this subarea can be designated as class 2 irrigation water except for well number 1, near El Cajon, and well number 5, on the lower Sweetwater River. Because of high chloride content in these two areas, the waters are designated as class 3 irrigation water.

San Diego County Subarea. Mineral analyses of samples from representative wells in the San Diego County subarea during 1962 are presented in Table 10. For these samples, the total dissolved solids content ranged from 354 to 1,650 ppm, electrical conductance from 680 to 2,350 micromhos per centimeter, and chloride content from 66 to 533 ppm. Most well waters in this subarea can be designated as class 2 irrigation water.

Local Surface Supplies. Local surface water supplies may be classed domestically as "moderately hard" and agriculturally as class 1 irrigation water. During 1962, samples were obtained from several San Diego surface water supplies, including Barrett Lake, El Capitan Reservoir, and Sutherland Reservoir. These three reservoirs, owned by the City of San Diego, were chosen as representative surface water supplies. The locations of these reservoirs are shown on Plate 1. Other reservoirs, such as Lake Hodges, San Vicente Reservoir, and Sweetwater Reservoir, are

TABLE 9

MINERAL ANALYSES OF GROUND WATERS IN
SAN DIEGO METROPOLITAN SUBAREA DURING 1962

Constituent*	Well No. 1 16S/1W-2K6	Well No. 2 15S/1W-30K2	Well No. 3 16S/2W-17L1	Well No. 4 16S/3W-5E1	Well No. 5 17S/2W-36D1	Well No. 6 18S/1W-19D1	Well No. 7 19S/2W-5Q2
pH	7.2	7.0	7.7	7.6	7.3	7.2	7.4
Electrical conductance	1,990	1,560	1,825	1,900	3,150	1,560	1,900
Calcium	130	77	98	56	196	76	144
Magnesium	61	67	41	43	78	35	26
Sodium	220	173	214	290	375	175	207
Potassium	1	2	3	6	1	1	4
Carbonate	0	0	0	0	0	0	0
Bicarbonate	318	288	415	419	446	219	299
Sulfate	177	122	146	183	318	75	232
Chloride	388	314	287	307	667	339	310
Nitrate	60.0	34.0	0	0	7.0	0	7.4
Fluoride	0.4	0.4	0.4	0.6	0.4	0.4	0.8
Boron	0.2	0.2	0.3	0.5	0.5	0.2	0.1
Silica	47	32	14	15	21	33	35
Total dissolved solids	1,324	948	1,006	1,106	1,932	850	1,111
Total hardness as $CaCO_3$	574	456	417	316	808	337	465
Percent sodium	45	45	53	66	50	53	49

*All chemical constituents are in parts per million, except pH, electrical conductance, and percent sodium. Electrical conductance is in micromhos per cm. at 25° C.

TABLE 10

MINERAL ANALYSES OF GROUND WATERS IN
SAN DIEGO COUNTY SUBAREA DURING 1962

Constituent*	Well No. 8 18S/5E-9K1	Well No. 9 11S/4W-33G1	Well No. 10 12S/2W-9C3	Well No. 11 13S/4W-23H1	Well No. 12 14S/2W-13L1	Well No. 13 13S/1E-17J2	Well No. 14 14S/3W-7P6	Well No. 15 10S/3W-12C1	Well No. 16 12S/4W-26H1	Well No. 17 9S/3W-17C1
pH	7.7	8.0	7.7	7.3	7.4	7.5	7.9	7.5	7.7	7.4
Electrical conductance	680	1,500	1,080	2,350	2,260	870	1,660	1,102	1,460	1,290
Calcium	59	63	88	104	133	46	101	76	46	83
Magnesium	18	35	29	75	66	23	45	50	28	56
Sodium	63	182	105	290	239	81	210	90	210	93
Potassium	4	1	5	3	1	3	13	5	2	4
Carbonate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	299	169	143	197	311	140	322	247	223	229
Sulfate	11	67	309	287	240	27	184	219	90	167
Chloride	66	337	97	533	434	156	318	103	282	207
Nitrate	7	0.0	2	7	6	31	0.0	1	0.0	0.0
Fluoride	0.4	0.2	0.4	1	1	0.8	0.1	0.4	0.6	0.1
Boron	0.1	0.4	0.1	0.3	0.1	0.0	0.4	0.0	0.3	0.1
Silica	28	33	10	38	47	46	18	25	35	34
Total dissolved solids	354	818	784	1,650	1,436	537	1,130	775	816	896
Total hardness as $CaCO_3$	220	302	337	568	603	210	435	393	231	439
Percent sodium	38	57	40	52	46	45	50	33	67	31

*All chemical constituents are in parts per million, except pH, electrical conductance, and percent sodium. Electrical conductance is in micromhos per cm. at 25° C.

supplemented with Colorado River water and thus are very similar in quality to the Colorado River supply.

The mineral analyses of the samples taken from the representative reservoirs were averaged, and the results are presented in Table 8. The total dissolved solids varied from 303 to 578 ppm, sulfates from 52 to 87 ppm, and the chloride content from 50 to 118 ppm. The results of the analyses indicate a water supply of satisfactory quality. The overall quality is somewhat better than that of the Colorado River supply.

Future Supplies. On completion of the California Aqueduct in 1972 the water supply for coastal San Diego County will include water from local sources, from the Colorado River, from waste water reclamation, from sea-water conversion, and from Northern California. The maximum limits of mineral quality of water from the State Water Project are presented in Table 11. This water should have a total dissolved solids content of 220 ppm and chloride content of 55 ppm. By the time the water is delivered in Southern California, it may be classed for domestic use as "moderately hard" and for agricultural use as class 1 irrigation water. The overall quality of the future coastal San Diego County water supply will be upgraded by the addition of Northern California water to existing sources.

Other possibilities of upgrading the quality of the water in the study area include the development and operation of sea-water conversion projects and demineralization of brackish waters. As water supply quality, and, therefore, waste water quality, reach a higher level, water reclamation possibilities will improve proportionately.

TABLE 11

MAXIMUM LIMITS OF MINERAL QUALITY FROM
THE STATE WATER PROJECT

Constituent	Unit	Monthly average	Average for any 10-year period	Maximum
Total dissolved solids	ppm	440	220	--
Total hardness	ppm	180	110	--
Chlorides	ppm	110	55	--
Sulfates	ppm	110	20	--
Boron	ppm	0.6	--	--
Sodium percentage	percent	50	40	--
Fluoride	ppm	--	--	1.5
Lead	ppm	--	--	0.1
Selenium	ppm	--	--	0.05
Hexavalent Chromium	ppm	--	--	0.05
Arsenic	ppm	--	--	0.05
Iron and manganese together	ppm	--	--	0.3
Magnesium	ppm	--	--	125
Copper	ppm	--	--	3.0
Zinc	ppm	--	--	15
Phenol	ppm	--	--	0.001

Domestic and Industrial Use

Domestic and industrial water use can result in extensive deterioration of the mineral quality of water. As previously discussed, the mineral content of the waste water depends on both the mineral content of the water supply and the particular use of the water.

The increase in mineralization resulting from domestic use was studied by the University of California at Los Angeles in preparing a report on waste water reclamation and utilization for the California State Water Quality Control Board. The results are presented in Table 12.

Chlorides are also introduced into waste water through the use of ion exchange water softeners. The results of a study on the "Effects of Water Softener Regeneration Wastes"(5) made in 1952 are presented in

TABLE 12

NORMAL RANGE OF MINERAL PICKUP IN
WATER USED FOR DOMESTIC PURPOSES*

Mineral constituent	Normal range, in parts per million (except as noted)
Total dissolved solids	100 - 300
Boron	0.1 - 0.4
Percent sodium	5 - 15**
Sodium	40 - 70
Potassium	7 - 15
Magnesium	15 - 40
Calcium	15 - 40
Total nitrogen	20 - 40
Phosphate	20 - 40
Sulfate	15 - 30
Chloride	20 - 50
Total alkalinity	100 - 150

*Adapted from State Water Pollution Control Board Publication No. 9, Chart I-8, page 25(16).
**In percent.

Table 13. The results of this study indicate a possible chloride increase ranging from 221 to 428 ppm, depending on the type of ion exchanger used.

Although the number of large water using industries in the study area is not very great, the wastes produced by these industries can exert a major influence on the mineral quality of resulting sewage flows. Certain types of industries, such as chemical, mining, and aircraft, produce wastes that are highly mineralized and cause gross deterioration of waste water quality.

Mineral Pickup Estimation

A method for estimating dissolved solids and chloride ion pick-up in waste waters based on water quality of the supply is presented in Figure 13. The plots are based on data collected in 1958 concerning the

TABLE 13

ESTIMATED INCREASE OF SODIUM CHLORIDE IN DOMESTIC SEWAGE FROM WATER SOFTENERS(5)

Assumption	Type of ion exchanger used			
	1 Synthetic zeolite gel	2 Synthetic zeolite gel	3 High capacity resin	4 High capacity resin
1. All wastes go to private sewage system				
2. Complete dilution in annual sewage flow				
3. Water supply hardness that of Metropolitan Water District's raw water (grains/gal.)	17.2	17.2	17.2	17.2
4. Domestic sewage (gal/cap./day)	50*	50*	50*	50*
5. Average capacity of the exchange medium (grains/cu.ft.)	14,000	14,000	27,000	27,000
6. Average quantity of salt for regeneration (lbs./cu. ft./exchanger/regeneration)	8	8	12	12
7. Water softened (gal./cap./day)	30	20	30	20
Salt increase as NaCl in sewage (ppm)	705	469	550	364
Salt increase as Cl, (ppm)	428	285	334	221
Salt increase as Na, (ppm)	277	184	216	143

*Assumed for worst conditions - sewage flow generally varies from 50 to 70 gal./cap./day in San Diego County.

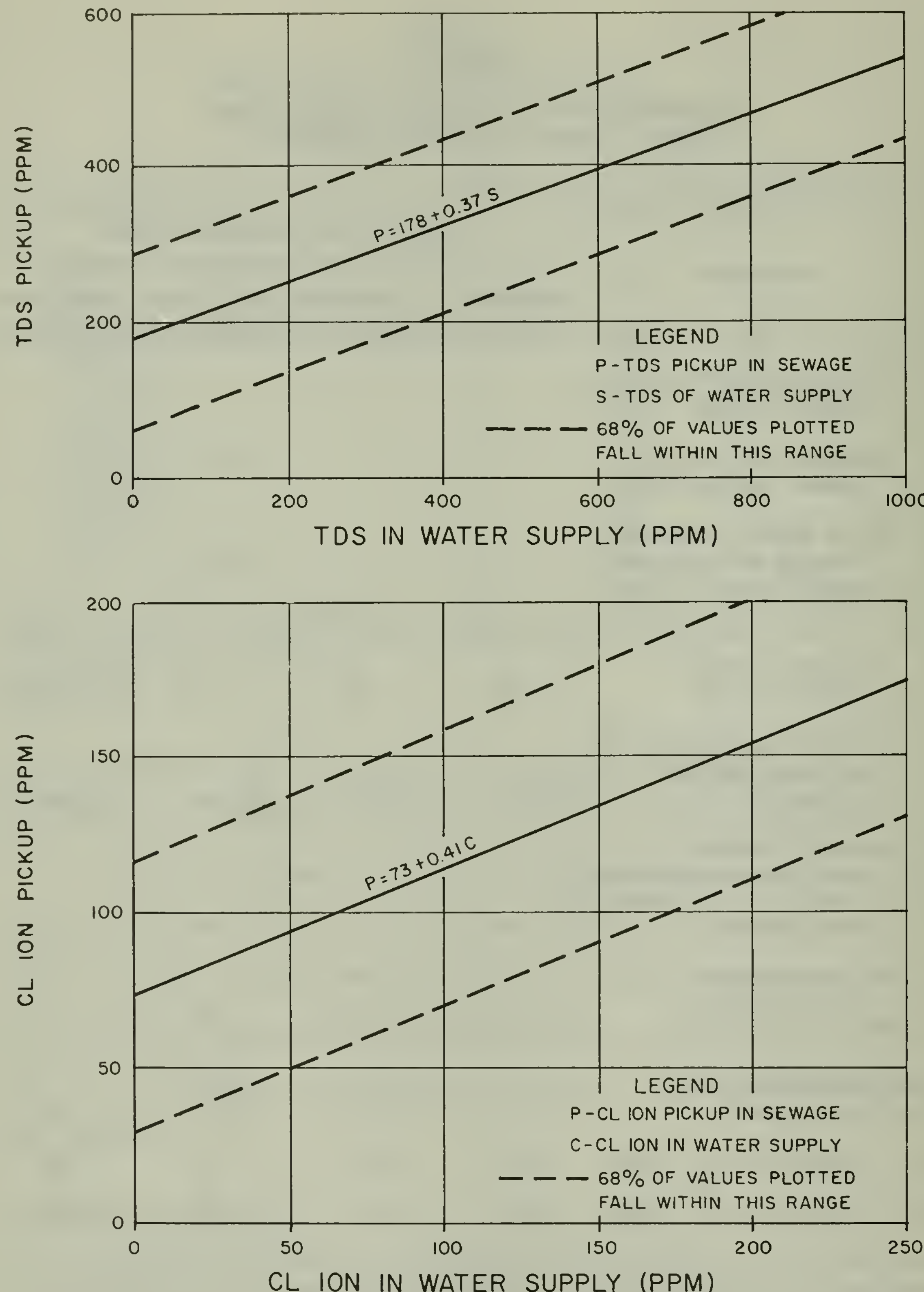


Figure 13-TOTAL DISSOLVED SOLIDS AND CHLORIDE ION PICKUP IN SEWAGE IN SOUTHERN CALIFORNIA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1967

mineral quality of water supplied and resulting waste waters for 20 cities in Southern California and for eight trunk sewers within the San Diego Metropolitan Sewerage System[4]. The actual ranges of the estimated solids and chloride ion pickup were calculated by the least squares method of determining the line of best fit. The dotted lines represent the expected range of pickup at a 68 percent confidence level. The probable dissolved solids and chloride ion pickup can be estimated from the amount present in the original water supply. These empirical curves should not be used for any areas other than Southern California, as any proportions of domestic, industrial, or agricultural wastes other than those found in this study could change the curves considerably.

Infiltration Water

Infiltration water is the water that enters sewers from the subsurface through poor joints, cracked pipes, and manhole walls, and from the surface through perforated manhole covers. The amount of infiltration depends on the quality of construction of the sewer system, the height of the ground water table, and the character of the soil. The quality of the infiltrating water will depend on its origin -- surface or subsurface. In general, surface infiltration waters are of good quality, but subsurface infiltration waters may vary greatly in quality. Subsurface infiltration has a pronounced effect in coastal areas where the infiltrating waters may be highly saline, thus producing gross deterioration of the waste water.

Other Factors

Use of such products as plastics, fibers, medicinal chemicals, dyes, and synthetic detergents has increased considerably during the past two decades. Some of these organic products find their way into waste waters through domestic and industrial use. In most instances, these organic products can be removed by conventional sewage treatment processes. A notable exception is phosphates contained in synthetic detergents. Another study by the Department of Water Resources, under contract with the State Water Quality Control Board, to evaluate the persistence and dispersion of synthetic detergents in the ground water along the Santa Ana River in the Riverside-Colton area, has been completed; and the final report was published September 1964. Synthetic detergents that can be broken down in normal sewage treatment are now on the market and have replaced the nondegradable detergents.

Quality of Waste Water and Suitability for Reclamation

Discharges from waste water treatment plants in the study area may be classified as being "very hard" for domestic use and ranging from class 2 to class 3 for irrigation. Several exceptions to this general classification are: the effluent from the Camp Pendleton subarea, which varies in hardness from "moderately hard" to "very hard"; the effluent from the Alpine Treatment Plant, which is "moderately hard"; and the effluent from the Julian plant, which is "moderately hard" and is class 1 for irrigation. Waste water quantity and quality in the study area are depicted in Figures 14 and 15 and on Plates 3A and 3B.

The suitability of a waste water to be reclaimed and used beneficially depends on many factors, the most significant of which is mineral quality. Especially important in determining suitability for reclamation is content of chloride, boron, sulfate, and total dissolved

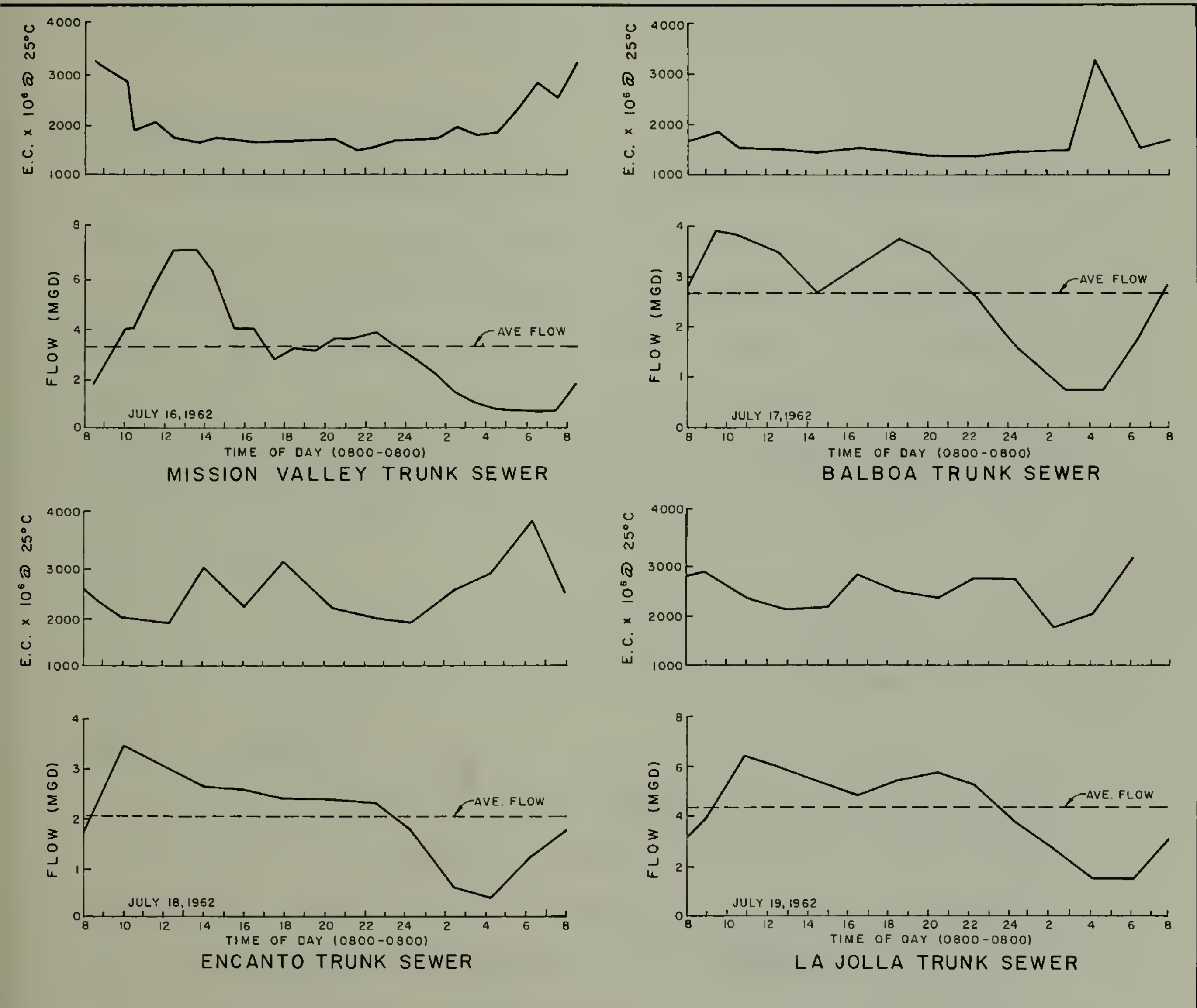


Figure 14-QUANTITY AND ELECTRICAL CONDUCTANCE OF FLOWS IN SAN DIEGO TRUNK SEWERS DURING JULY 1962

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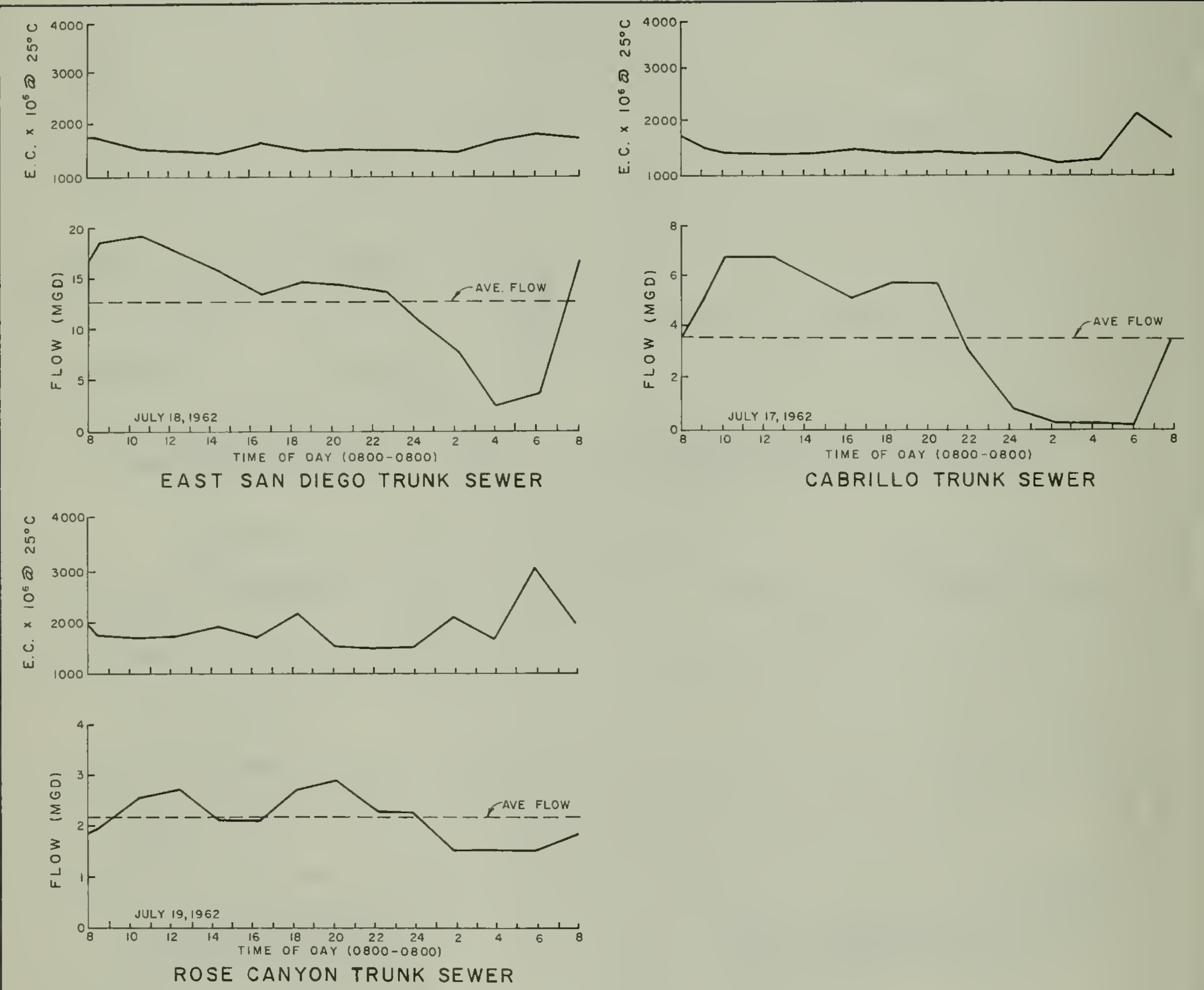

Figure 15 - QUANTITY AND ELECTRICAL CONDUCTANCE OF FLOWS IN SAN DIEGO TRUNK SEWERS DURING JULY 1962

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1967

solids. Based on these criteria, a waste water is classified as suitable, marginal, or unsuitable according to limits shown in Table 6.

The quality of plant discharges and their classification according to suitability for reclamation are discussed in the following section under appropriate subareas.

San Diego Metropolitan Subarea

Mineral analyses of samples from plant effluents in the metropolitan subarea are presented in Table 24 of Appendix D. Those most significant in determining suitability for reclamation are summarized in Table 14. One discharge is rated suitable -- the one at the Coronado "B" Street outfall. Nine discharges are classed as marginal for original reclamation purposes and four are classed as unsuitable. These are from Gillespie Field, Imperial Beach, Palm City, and San Diego Harbor Drive Treatment Plants.

Mineral analyses of samples from some of the trunk sewers that make up the San Diego Metropolitan Sewerage System are presented in Table 25, Appendix D.

The San Diego Metropolitan Sewerage System includes a number of trunk sewers which carry waste waters that are marginal for reclamation purposes. These trunk sewers are listed in Table 15, together with mineral concentrations and appropriate classifications.

On the basis of the data shown in Tables 14 and 15 and the information on quantity of waste waters presented in Appendix D, the approximate quantities of waste water in each classification are: 0.4 mgd, suitable; 40.8 mgd, marginal; and 18.6 mgd, unsuitable. Of the marginal

TABLE 14

MINERAL QUALITY OF WASTE WATER FROM SEWAGE PLANTS IN SAN DIEGO METROPOLITAN SUBAREA

Plant	Mineral quality concentrations, in parts per million				Suitability of mineral quality	Irrigation classification
	TDS	Cl	$Cl + SO_4$	B		
Chula Vista ("G" Street plant)	1,200	197	506	1.0	Marginal	2
("J" Street plant)	1,610	283	391	1.1	Marginal	2
Coronado ("B" Street outfall)	785	94	417	0.0	Suitable	2
("K" Street outfall)	1,365	395	721	0.2	Marginal	3
El Cajon	1,690	381	689	1.0	Marginal	3
Gillespie Field	1,004	238	412	3.5	Unsuitable	3
Imperial Beach	11,028	5,754	6,685	1.6	Unsuitable	3
Lakeside	1,436	327	779	0.9	Marginal	2
Palm City	4,232	2,184	2,580	1.2	Unsuitable	3
Ream Field	1,252	325	525	0.6	Marginal	2
San Diego (Harbor Drive)	1,950	534	823	1.3	Unsuitable*	3
Santee	1,125	220	518	0.9	Marginal	2
San Ysidro	1,266	280	685	0.7	Marginal	2
Spring Valley	1,850	459	879	1.3	Marginal	3

*A portion of the flow from the Harbor Drive plant was considered marginal based on analyses of samples from trunk sewers.

TABLE 15

MINERAL QUALITY OF WASTE WATER FROM
TRUNK SEWERS IN SAN DIEGO METROPOLITAN SUBAREA

Plant	Mineral quality concentrations in parts per million				Irrigation classification
	TDS	Cl	Cl + SO_4	B	
Balboa	1,026	144	506	0.8	2
Cabrillo	1,064	145	493	0.8	2
East San Diego	1,300	202	575	0.8	2
Encanto	1,696	420	795	0.8	3
La Jolla	1,892	459	843	0.6	3
Linda Vista	1,060	160	497	1.2	2
Mission Valley	1,180	232	568	0.9	2
Murray Canyon	1,172	150	420	0.6	2
National City	1,056	194	330	0.6	2
Rose Canyon	1,124	229	608	1.0	2

waste water, approximately 31.2 mgd is flow handled by the San Diego trunk sewers. Thus, even with the generally poor quality of water supply now available, about 41.2 mgd of sewage in the San Diego metropolitan subarea can be reclaimed. The deliveries of high quality Northern California water expected in 1972 should increase the percentage of waste water which can be reclaimed, as well as move a greater proportion of it into the "suitable" category. Under the present operation of the San Diego Metropolitan Sewerage System, about 40 mgd of reclaimable sewage in the metropolitan subarea is discharged to the ocean. This amounts to 74 percent of the total flow discharged to the ocean.

POINT LOMA LABORATORY

Waste water from the City of San Diego's treatment plants undergoes careful analysis in this laboratory.

San Diego County Subarea

Mineral analyses of samples from plant effluents in the county subarea are presented in Table 26, Appendix D. Table 16 shows the classification according to suitability for reclamation. These data show that approximately 0.06 mgd are suitable, about 8.2 mgd are marginal, and approximately 0.7 mgd are unsuitable for reclamation. Of an available 9.0 mgd, about 8.3 mgd of sewage in the county subarea can presently be used for waste water reclamation; and, as with the San Diego metropolitan subarea, the proportion can be expected to increase with the delivery of Northern California water.

Camp Pendleton Subarea

Mineral analyses of samples from plant effluents in the Camp Pendleton subarea are presented in Table 27, Appendix D. Table 17 summarizes the classification according to suitability for reclamation. All of these waste waters, 3 mgd, are usable for reclamation.

TABLE 16

MINERAL QUALITY OF WASTE WATER FROM SEWAGE PLANTS IN SAN DIEGO COUNTY SUBAREA

Plant	Mineral quality concentrations, in parts per million				Suitability of mineral quality	Irrigation classification
	TDS	Cl	$Cl + SO_4$	B		
Alpine	814	171	303	0.8	Suitable	2
Callan	1,008	196	558	0.3	Marginal	2
Cardiff	1,365	272	614	0.9	Marginal	2
Carlsbad	2,080	789	1,068	0.5	Unsuitable	3
Del Mar	1,390	340	720	0.9	Marginal	2
Encinatas	1,550	288	635	1.3	Marginal	2
Escondido (old plant)	1,450	326	646	0.7	Marginal	2
(new plant)	1,292	284	607	0.9	Marginal	2
Fallbrook	1,020	182	526	0.7	Marginal	2
Julian	328	50	98	0.3	Suitable	1
Oceanside	1,728	470	792	0.8	Marginal	3
Pomerado	1,254	308	649	0.8	Marginal	2
Ramona	1,198	298	516	0.8	Marginal	2
Rancho Del Campo	758	127	208	0.5	Suitable	2
Rancho Santa Fe	1,468	332	662	0.4	Marginal	2
San Marcos	1,265	256	564	0.1	Marginal	2
Solana Beach	2,070	725	1,074	0.6	Unsuitable	3
Sorrento	7,970	2,613	4,936	1.1	Unsuitable	3
Viejas Honor Camp	746	138	193	0.2	Suitable	2
Vista	1,320	286	499	0.1	Marginal	2

TABLE 17

MINERAL QUALITY OF WASTE WATER FROM
SEWAGE PLANTS IN CAMP PENDLETON SUBAREA

Plant	Mineral quality concentrations, in parts per million				Suitability of mineral quality	Irrigation classification
	TDS	Cl	Cl + SO_4	B		
Camp Pendleton						
Plant No. 1	950	211	345	0.6	Marginal	2
Plant No. 2	746	196	307	0.3	Suitable	2
Plant No. 3	982	308	432	0.6	Marginal	2
Plant No. 8	940	218	338	0.5	Marginal	3
Plant No. 9	1,305	322	388	0.5	Marginal	2
Plant No. 10	880	180	278	0.6	Suitable	2
Plant No. 11	1,015	246	336	0.4	Marginal	2
Plant No. 12	615	160	252	0.3	Suitable	2
Plant No. 13	1,092	275	421	0.6	Marginal	2
Fallbrook Naval Reservation	1,070	--	--	--	--	-

CHAPTER V. WASTE WATER RECLAMATION PROJECTS

Reclaimed water from domestic and industrial wastes has long been used for agricultural irrigation in the arid and semiarid regions of the Southwest. Reclaimed water is also used to create artificial lakes and streams for recreation, to provide fish and wildlife enhancement, to replenish ground water basins, to operate sanitary systems and to provide cooling water for industrial purposes.

Waste water reclamation may be planned, incidental, or involuntary. Planned reclamation is recovery of water primarily for beneficial uses. Incidental reclamation is the reuse of waste effluent discharged from plants that are operated primarily for sanitary disposal. Involuntary reclamation takes place when the waste water mingles with water from other supply sources, such as in lakes, streams, or ground water.

For the purposes of this study, planned reclamation is divided into two classes. In class A planned reclamation, the facility is built specifically for waste water reclamation, is located apart from the sewage treatment or disposal plant, and operates separately from it. In class B planned reclamation, the facility is operated in conjunction with waste water treatment or disposal.

Few planned reclamation systems are in operation in the country, although numerous examples of incidental and involuntary reclamation may be found. A good example of class A planned reclamation is the Los Angeles County Sanitation District's Whittier Narrows Reclamation Plant near Whittier, where water is reclaimed for ground water recharge. Here, 14 mgd of domestic waste from a trunk sewerline is treated and spread for ground water replenishment. Operation of the plant has been very successful, and plans are being made to expand the plant to 125 mgd.

In coastal San Diego County, all three types of waste water reclamation are practiced. Planned reclamation is practiced at Santee, Lawrence Welk's Country Club Village, Encinitas, Oceanside, Camp Pendleton, Rancho Bernardo, and other areas. Incidental reclamation is used at Fallbrook, Julian, Callan, Escondido, and Ramona. Involuntary reclamation occurs at Alpine, Lakeside, Poway (Pomerado), and San Marcos.

Feasibility of Waste Water Reclamation

Before the reclamation of waste water is considered, an adequate source of usable water must be available, a sufficient demand for reclaimed water must exist, the project must be economically feasible, and the agency financing the project must be sure it has legal protection for its investment.

The questions of available quantity and quality of waste waters were discussed in the two preceding chapters. This chapter will explore the other questions and will also describe the present, proposed and potential waste water reclamation projects in the study area.

Costs of Waste Water Reclamation

The costs of reclaiming water from a class B plant should be much less than from a class A plant because the class B plant is being used for both sanitary disposal and reclamation. Since the costs of sanitary disposal must be incurred by a community whether or not it engages in water reclamation, the principal cost of reclamation will be those costs for treatment beyond the conventional sanitary disposal requirements.

The costs used here for reclaiming water are those for class A plants, as are proposed for the metropolitan subarea. As was pointed out earlier, each agency using the Metropolitan Sewerage System pays an operating cost based on the amount of sewage it discharges to the system (generally about $14 per acre foot). In computing their costs for reclaiming water, these agencies can deduct this charge from their cost for each acre-foot reclaimed. It is recognized that operation and maintenance of the system will be affected by reduction of influent flows.

Costs of reclamation vary, depending on the quantity of waste water needed, type of treatment, operation, storage, transmission, and water use.

At present, the activated sludge-type treatment is favored for waste water reclamation. Figure 16, based on past studies (2,18,19,20)*, gives the costs per acre-foot for constructing and operating activated sludge-type plants. (The annual construction costs component was based on a capital recovery factor of the capital costs at 5 percent interest and an expected average life of 25 years for structures and mechanical equipment.) Preliminary treatment and most of the sludge handling are not required for class A plants and are not included in these cost estimates. The sludge may be disposed of in the waste water line from which the water is reclaimed or by incineration. Sufficient residual flow can easily be maintained to carry the sludge to the treatment plant concerned. Additional cost of sludge disposal should be considered.

Water use determines the treatment, storage, and size of treatment plant required. For an irrigation system in coastal San Diego County,

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*Numbers in parentheses indicate references listed in Appendix A.

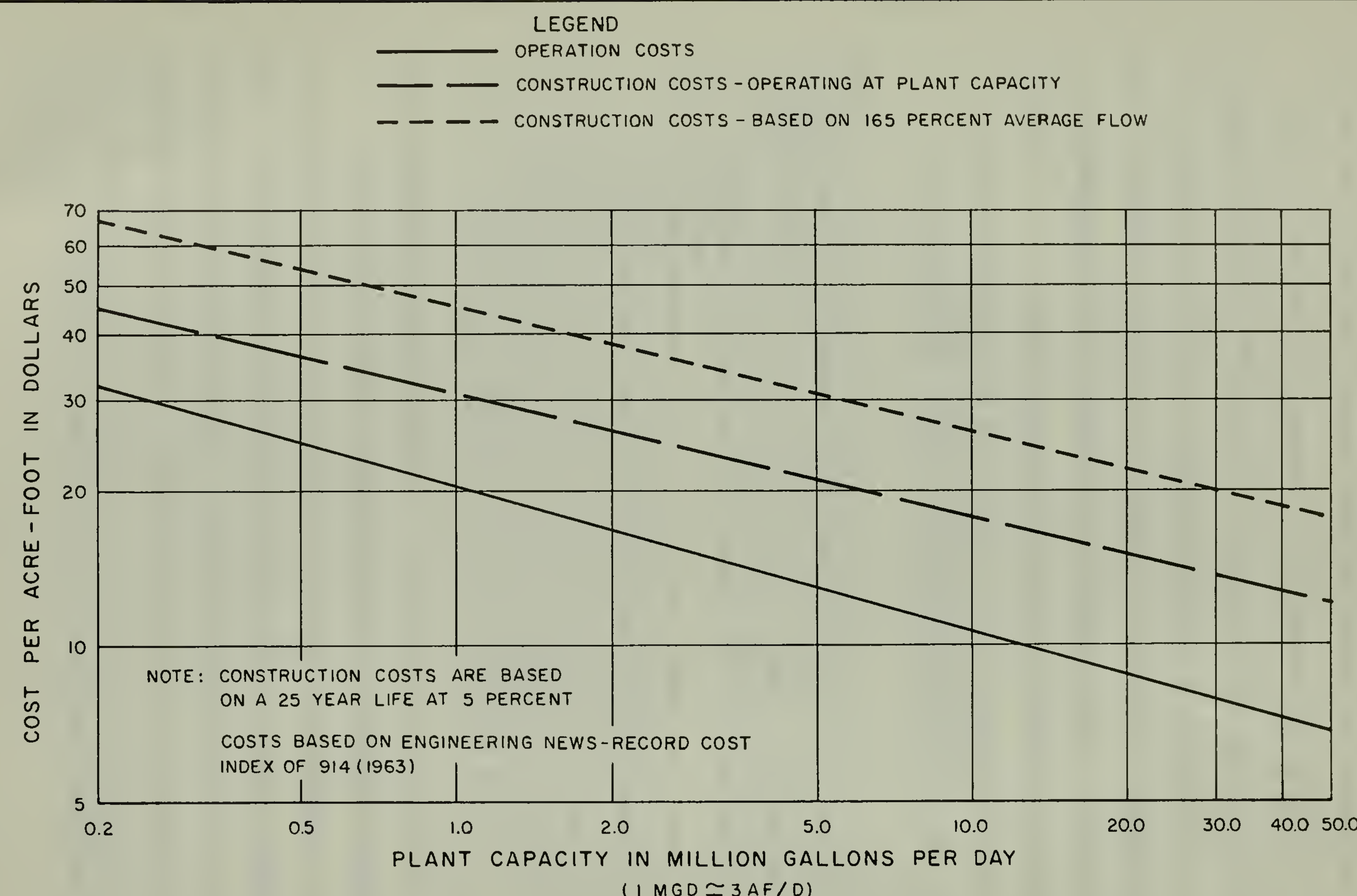


Figure 16-CONSTRUCTION AND OPERATION COSTS FOR ACTIVATED SLUDGE-TYPE WASTE WATER RECLAMATION PLANTS

the treatment plant would need to be designed for flows of 165 percent of average daily flow. The design capacity of plants using the effluent for irrigation was based on 165 percent of average daily flow, using the July demand in Table 18 as the maximum expected. Storage of the waste water before transmission is necessary for fluctuations of demand and unexpected shutdowns. For irrigating parks and golf courses, the water is applied when the park or golf course is not in use. A one-day supply for maximum demand should be sufficient for storage.

Quantities of water needed for golf courses, parks, and freeway landscaping in coastal San Diego County are 2 to 3 acre-feet per acre per year. Monthly requirements, as obtained from Bulletin No. 61[9], vary as shown in Table 18.

TABLE 18

MONTHLY DEMAND FOR RECLAIMED WASTE WATER FOR IRRIGATED AGRICULTURE IN SAN DIEGO METROPOLITAN SUBAREA*

Month	Monthly demand in percent of total annual demand
January	2.7
February	2.2
March	3.8
April	6.5
May	10.9
June	12.8
July	13.7
August	13.6
September	12.5
October	9.5
November	7.2
December	4.6
TOTAL	100.0

*Adapted from Department of Water Resources Bulletin No. 61, "Investigation of Alternative Aqueduct Routes to San Diego County", page 65.(9)

The cost of storing and transmitting waste water includes cost of storage facilities, transmission pumps and structure, transmission pipe, and other land or equipment needed to transport the water to the irrigation site. Costs of storage and transmission depend on volume of storage, size of mains, distance, and difference in elevation between storage and point of distribution.

The nutrient value of waste water is very important when this water is used for irrigation. Although nutrients contribute to the fertilizer value of waste water, they may or may not lower the overall cost to the individual user when used for recreation lakes, because of difficulties encountered in the control of algae produced by excess nutrients. Costs of nutrient removal and the nutrient value of waste water were not considered in calculating the costs of reclaimed water.

Legal Requirements

With the qualifications pointed out in Chapter IV, the necessary relationships for the use of reclaimed water fall into established contractual and water rights patterns. The user of reclaimable water would want to assure himself of rights to a firm enough supply to warrant investment in treatment facilities. Agreements concerning the quality of the reclaimed water and liability for failures in the system should be executed between the producer or entity in possession of the waste water and the party reclaiming the water. Agencies having responsibility for purveying water and for waste water collection and disposal need not be concerned with legal problems of water ownership.

Public agencies should be certain that they have the authority to enter into the necessary agreements to use reclaimable water. Authority to sell or dispose of effluent for reclamation is expressly granted by Health and Safety Code, Section 5008, to cities, counties, corporations, and districts operating sewage treatment systems.

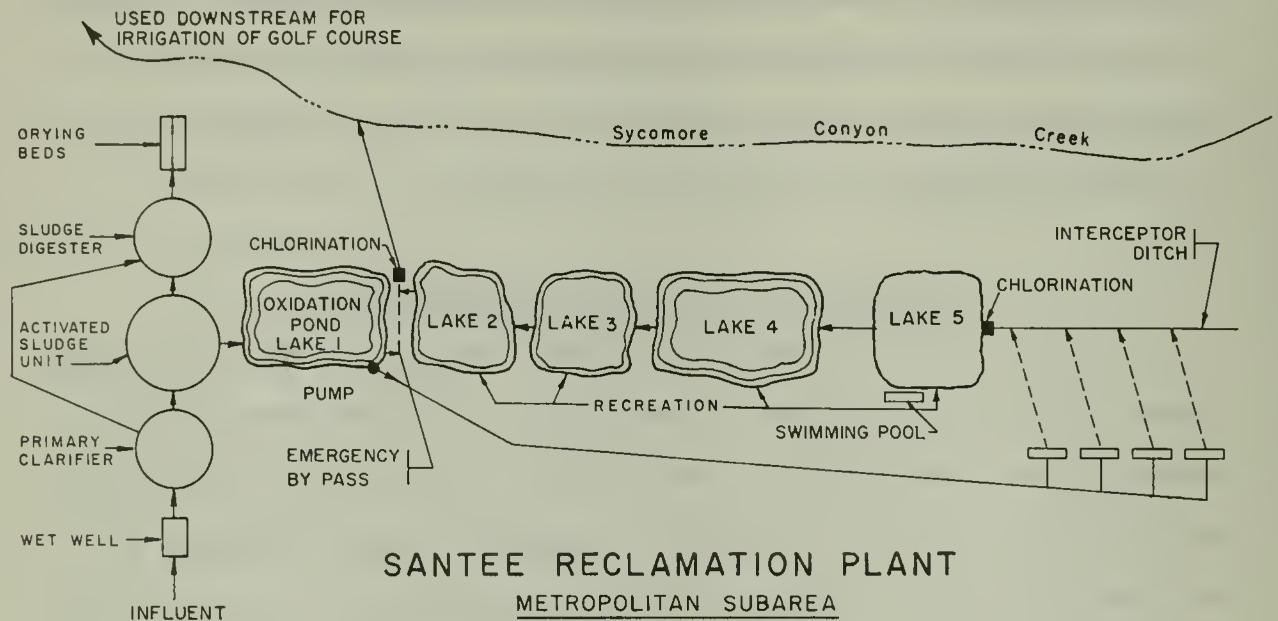
Existing Waste Water Reclamation Projects

Waste water is reused in all three subareas of coastal San Diego County. About 18,000 acre-feet of waste water was reused during 1962-63 through planned, incidental, or involuntary reclamation in the study area. They are located on Plates 2A and 2B. Diagrams of some of the class B waste water reclamation systems are shown in Figures 17, 18, and 19. The existing reclamation systems, other than the Point Loma plant in coastal San Diego County, are discussed in the following paragraphs.

San Diego Metropolitan Subarea

Since the completion of the new San Diego Metropolitan Sewerage System, only four waste dischargers not connected to the Point Loma Treatment Plant remain in the metropolitan subarea. These are at Lakeside, Santee, Ream Field, and Brown Field. Involuntary reclamation is practiced at Lakeside and Ream and Brown Fields. Planned reclamation occurs at Santee.

Lakeside. The Lakeside Sanitation District discharges its secondary treated effluent to percolation beds in the San Diego River. The treated effluent from the secondary plant is spread over 96,000 square



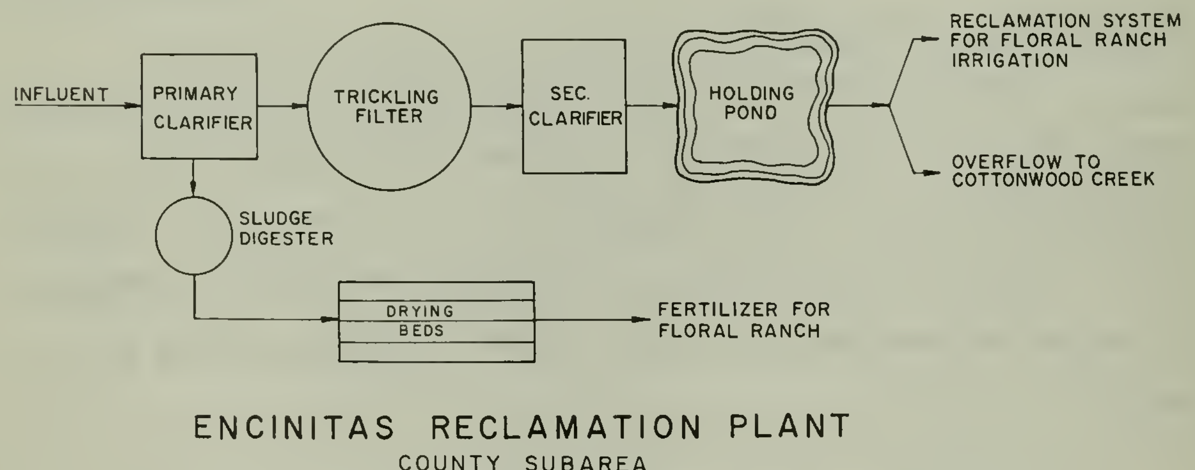


Figure 17-FLOW DIAGRAMS FOR EXISTING CLASS B PLANNED WASTE WATER RECLAMATION PLANTS IN THE METROPOLITAN AND COUNTY SUBAREAS

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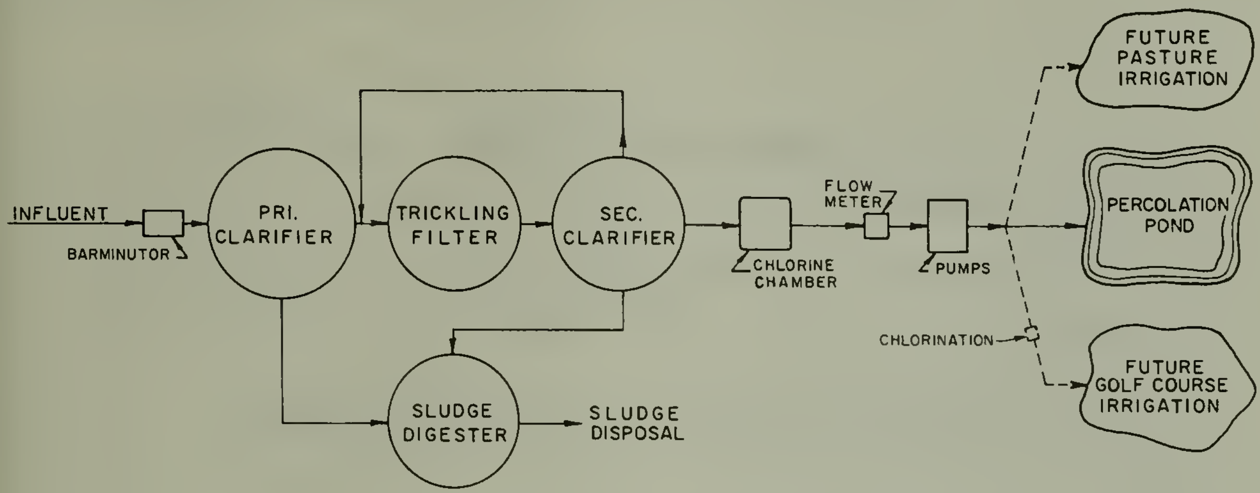
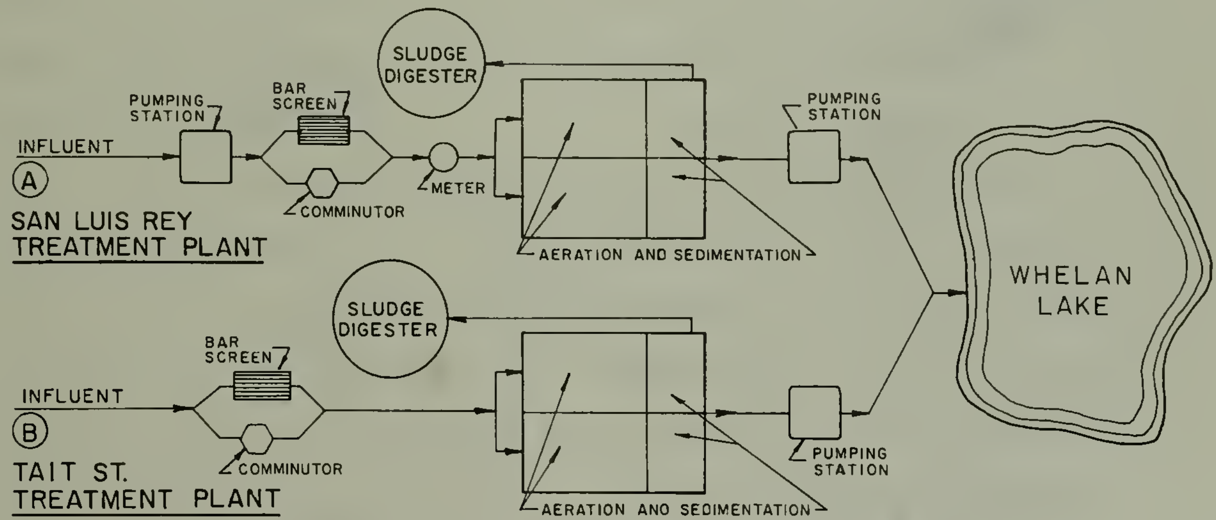


LEUCADIA RECLAMATION PLANT



OCEANSIDE RECLAMATION PLANT

Figure 18-FLOW DIAGRAMS FOR EXISTING CLASS B PLANNED WASTE WATER RECLAMATION PLANTS IN THE SAN DIEGO COUNTY SUBAREA

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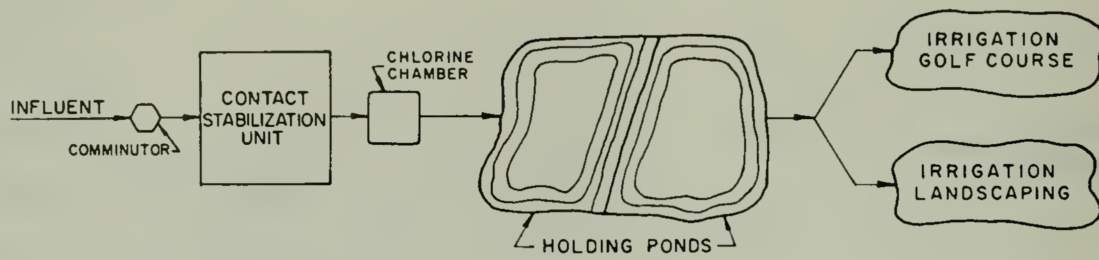
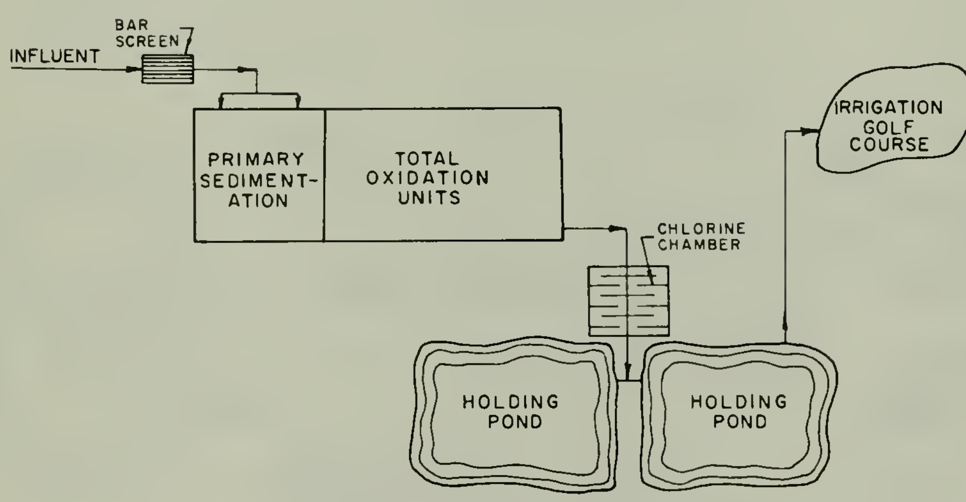


RANCHO BERNARDO – RECLAMATION PLANT



VALLE VERDE RECLAMATION PLANT

Figure 19-FLOW DIAGRAMS FOR EXISTING CLASS B PLANNED WASTE WATER RECLAMATION PLANTS IN THE SAN DIEGO COUNTY SUBAREA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1967

feet of sand and percolates into the underlying ground water basin. About 320 acre-feet per year, in 1965-66, were reclaimed.

Santee. Since 1961, the Santee County Water District has owned and operated a planned waste water reclamation system of small lakes for recreation. Figure 17 shows a schematic diagram of this system. The Santee waste water undergoes secondary treatment to meet sanitary quality requirements. The effluent from secondary treatment flows by gravity to a 16.3-acre oxidation pond (Lake 1) of about 74 acre-foot capacity for further treatment before being pumped about a mile upstream to Sycamore Canyon. The effluent then percolates into the shallow aquifer in Sycamore Canyon, where it mingles with the existing ground water. After traveling about 400 feet through the soil, the effluent is collected by an interception ditch. It is then chlorinated before entering the uppermost recreational lake, Santee Lake 5.

Lake 5 has a surface area of 11 acres and contains about 54 acre-feet of water. From Lake 5 the water flows to Lake 4. Lake 4 has a surface area of 11 acres and contains about 53 acre-feet of water. Water from Lake 4 flows to Lake 3, which has a surface area of 7.5 acres and contains about 46 acre-feet of water. From here, the water goes to Lake 2, which has a surface area of 6.8 acres and a capacity of about 36 acre-feet of water. The effluent from Lake 2 is chlorinated and then discharged into Sycamore Canyon Creek, a tributary of the San Diego River. Effluent from Lake 1 that is not pumped to the spreading area

Courtesy Santee County Water District

SANTEE

Reclaimed water fills the five lakes in the Santee recreational area is also chlorinated and discharged to the creek. Water leaving Lake 1 and 2 is pumped from wells downstream from the recreational area and used to irrigate a golf course.

Facilities at the Santee County Water District recreational area include a swimming pool, picnic tables, barbecue pits, restrooms, children's playground equipment, horseshoe courts, boatloading ramp, a boat dock, a boathouse, rental sailboats, and rental rowboats.

Brown Field. The Brown Field waste water treatment plant, now operated by the City of San Diego, is a secondary treatment facility. The final effluent from the treatment plant discharges into sand filter beds that overflow into a dry wash tributary to the Tia Juana River.

Ream Field. The effluent of the U. S. Naval Auxiliary Air Station is from a primary treatment plant that discharges into the Tia Juana River channel.

San Diego County Subarea

In the county subarea, wastes are discharged from 29 separate systems. Ten are class B planned reclamation systems; an eleventh is under construction. Incidental reclamation occurs at six locations in the county subarea.

Primary treatment occurs at Encina and San Elijo treatment plants. Final disposal is through ocean outfalls. Involuntary waste water reclamation either occurs or can occur at all other discharge sites. At eleven sites, involuntary reclamation is the only type of reclamation that occurs.

Planned and Incidental Reclamation. The ten class B planned reclamation systems now in operation in the county subarea are at Lawrence Welk's Country Club Village, Oceanside, Leucadia, Encinitas, Rainbow Municipal Water District - Gird Road Plant, Rancho Bernardo, Valle Verde, Warner Springs Guest Ranch. At Valley Municipal Water District, a class B planned reclamation plant is under construction.

Incidental reclamation occurs at Fallbrook, Ramona, Escondido, Rancho Santa Fe, Callan and Julian.

In the San Luis Rey drainage basin, the Fallbrook Sanitary District has a second waste water treatment plant under construction.

Callan. The effluent from the San Diego Callan waste water treatment plant is reclaimed and used by General Atomic's laboratory for irrigating its landscaped areas. The reclamation system has been in operation since the reactivation in February 1958 of a plant built in 1942 to serve Camp Callan.

Encinitas. All the waste effluent from the Encinitas Sanitary District waste water treatment plant is reclaimed for irrigation. The disposal plant was enlarged in 1957 to provide for both sewage disposal and waste water reclamation. The plant was again enlarged in 1966. This class B planned reclamation system provides irrigation water to a flower farm about 1 mile east of the plant. When available, up to 1 mgd can be used at the farm. A schematic diagram of the system is shown in Figure 17.

Escondido. Effluent from the Escondido waste water treatment plant is discharged to Escondido Creek. Some of the effluent is taken from the creek for gravel washing. The remainder of the waste water effluent infiltrates to the ground water.

Fallbrook. Part of the effluent from the Fallbrook Sanitary District waste water plant is reclaimed incidentally to irrigate lemon groves. The remainder of the effluent percolates into the bed of Fallbrook Creek, which results in involuntary reclamation.

Julian. Effluent from the Julian Sanitation District waste water plant is used to irrigate an apple orchard. The District discharges the waste effluent to Coleman Creek, where it is impounded in three ponds. Water is taken from the farthest downstream pond for irrigation.

Lawrence Welk's Country Club Village. Effluent from the waste water treatment plant is now being used to irrigate an 18-hole golf course. Effluent is pumped from the treatment plant to storage lakes on the golf course. Plans are now under way to enlarge the treatment facilities to handle larger flows.

Leucadia. Leucadia County Water District has been operating a new waste disposal and class B reclamation plant since early in 1963. The effluent is being used for irrigating a 150-acre golf course east of the plant, and pasture immediately west of the plant. A schematic diagram of the system is shown in Figure 18.

Oceanside. All the waste effluent from Oceanside is pumped to Whelan Lake for class B reclamation. Waste water in Whelan Lake recharges the Mission Valley Ground Water Basin, thereby supplementing the City's water supply and protecting the ground water basin against sea-water intrusion. This reclamation system has been in operation since July 1958; it was preferred to an ocean outfall discharge because of economics. A schematic diagram is shown in Figure 18.

The reclamation facilities consist of three secondary treatment plants, a pump station, and a pipeline to Whelan Lake. The lake serves as a spreading ground to recharge the underlying ground water basin, and for irrigation of farm lands at the Whelan Ranch.

Rainbow Municipal Water District - Gird Road Plant. Effluent from the treatment plant is pumped to an 18-hole golf course, where the effluent is then used for irrigation of the driving ranges.

Ramona. At Ramona, waste water is reclaimed incidentally for irrigation from the Ramona Sanitation District waste water plant. Waste water effluent that is not used for irrigation percolates in the Santa Maria Creek bed.

Rancho Bernardo. A class B reclamation system is operated by the City of San Diego at Rancho Bernardo south of Lake Hodges. This system serves as a waste disposal plant as well as a waste water reclamation system. The effluent is used to irrigate a golf course. A schematic diagram is shown in Figure 19.

Rancho Santa Fe. The Rancho Santa Fe Sanitation District spreads all its waste water effluent for ground water recharge, using more than 4,000 square feet of percolation area in the bed of the San Dieguito River.

Valle Varde. Effluent from the Valle Verde Community Services District waste water treatment plant will be used to irrigate a golf course. The class B reclamation plant was recently constructed to serve a housing development. A schematic diagram is shown in Figure 19.

Warner Springs Guest Ranch. Effluent from the secondary class B waste water treatment plant is pumped to a storage lake on a golf course where the effluent is used for irrigation.

Involuntary Reclamation. Eleven waste water disposal systems in the county subarea have involuntary reclamation only. These are:

Alpine. Waste water is discharged to Alpine Creek and percolates into the ground water basin.

Del Mar. Waste effluent percolates into the bed of the San Dieguito River.

Hide-Away Lake Mobile Estates. Effluent from the secondary treatment plant is spray irrigated downstream from the plant.

Pomerado County Water District. Effluent from the Pomerado County Water District's waste water treatment plant serving Poway Valley is discharged to Los Penasquitos Creek.

Rancho Del Campo. Waste water is discharged to Campo Creek and percolates into the ground.

Rainbow Municipal Water District - 76 Plant. Effluent from the secondary waste water treatment plant is discharged to the San Luis Rey River, where it percolates into the ground.

Rainbow Municipal Water District - San Luis Rey Plant. Waste water is discharged to two percolating ponds in Moosa Canyon.

San Marcos. Waste water is discharged to San Marcos Creek and percolates into the ground. Plans are now under way to connect to the Encina Water Pollution Control Facility.

Sorrento. Waste water percolates into Los Penasquitos Creek for ground water basin recharge.

Utah Construction. Waste water percolates into the ground water basin.

Viejas Honor Camp. Waste water effluent is discharged to a tributary of Sweetwater River and percolates into the ground.

Camp Pendleton Subarea

Waste water has been reclaimed for many years at Camp Pendleton Marine Corps Base. Effluent from eleven sewage treatment plants in Camp Pendleton is reused for recreation, irrigation, ground water recharge, and protection against sea-water intrusion. Waste water effluent from the Fallbrook Naval Reservation is involuntarily reclaimed in Camp Pendleton.

Reclamation at Camp Pendleton is undertaken by class B systems. The camp was forced into waste water reclamation by a shortage of ground water underlying the area, its only source of supply.

Effluent from Sewage Treatment Plant No. 2 is used to irrigate a golf course. Lake O'Neill, a recreational lake, receives the flow from Sewage Treatment Plant No. 1. The remainder of the sewage effluent discharged on the base percolates into the ground. Operation of the reclamation systems has been very successful.

Proposed Waste Water Reclamation Projects

Several waste water reclamation projects have been proposed for coastal San Diego County. These projects include park irrigation, golf course irrigation, and ground water recharge. The major proposed reclamation projects (Figure 20) are in the San Diego Metropolitan subarea.

San Diego Metropolitan Subarea

A plan for reusing waste water to irrigate Balboa and Mission Bay Parks [2] is still under consideration by the San Diego City Council. Balboa Park contains approximately 1,400 acres near the center of the City of San Diego. Mission Bay Park, in the northern part of the city, contains approximately 4,600 acres, of which almost half is water. The plan also includes future uses of reclaimed water, such as irrigation of greenbelt areas and ground water recharge.*

Irrigation and ground water recharge are potential beneficial uses for reclaimed water. The estimated average daily reclaimed water requirement in an ultimate peak month is 4 mgd for Balboa Park and 6 mgd for Mission Bay Park. An irrigation water requirement of about 22 mgd during peak summer months is predicted for greenbelt areas in metropolitan San Diego. Greenbelt areas, amounting to 9,663 acres, include recreational and athletic fields, cemeteries, parks, and golf courses, but do not include scenic freeways. Scenic freeways were estimated to be more than 65 linear miles. An average daily water consumption of almost 3 mgd, or 45,000 gallons per mile, would be required for scenic landscaping on freeways.

Recommended are two reclamation plans, plan 1 and plan 2. In plan 1, a single waste water reclamation plant, at an overall project cost

*Underground storage by artificial recharge is a beneficial use if the water is later used.

From the Historical Collection of Title Insurance and Trust Company

MISSION BAY

Metropolitan San Diego in the background.

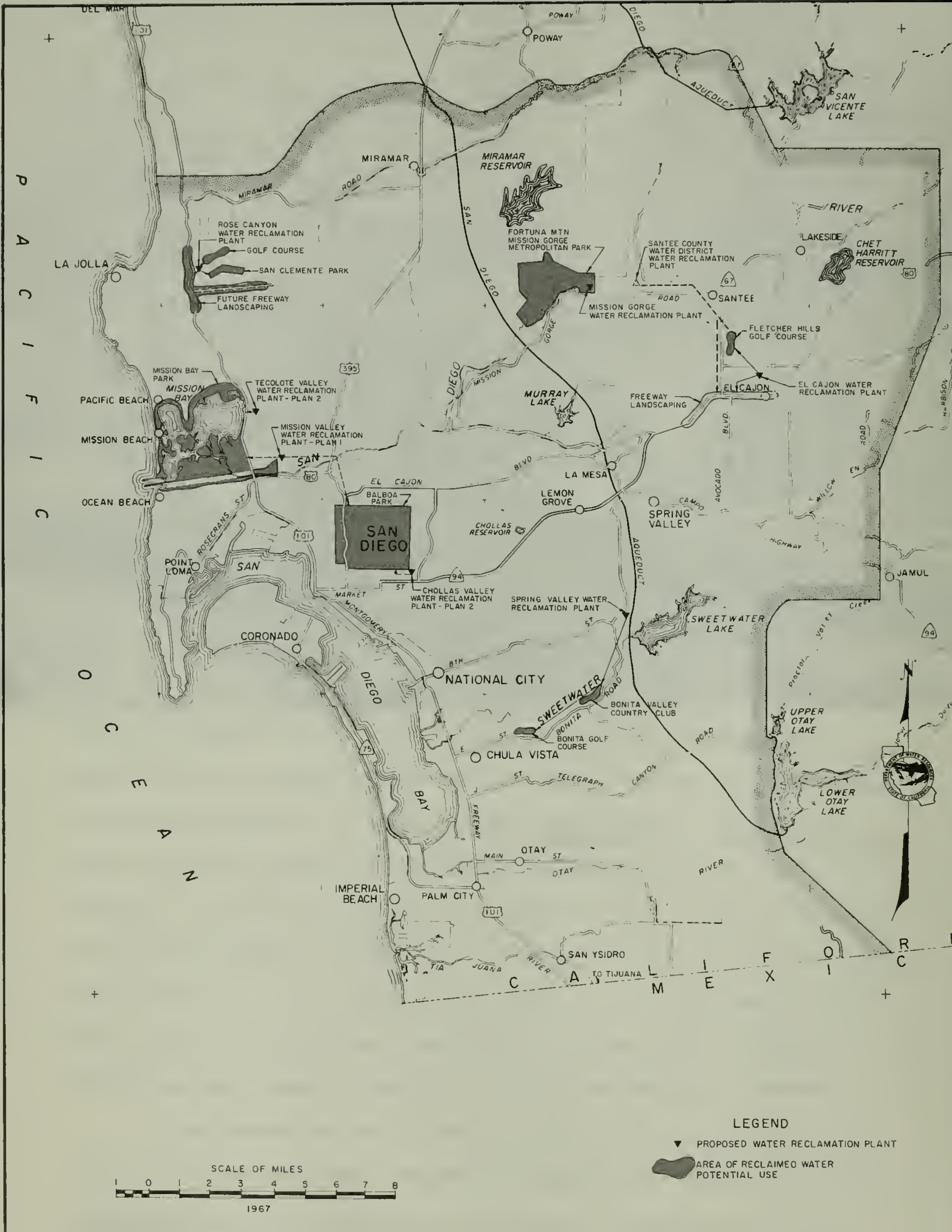
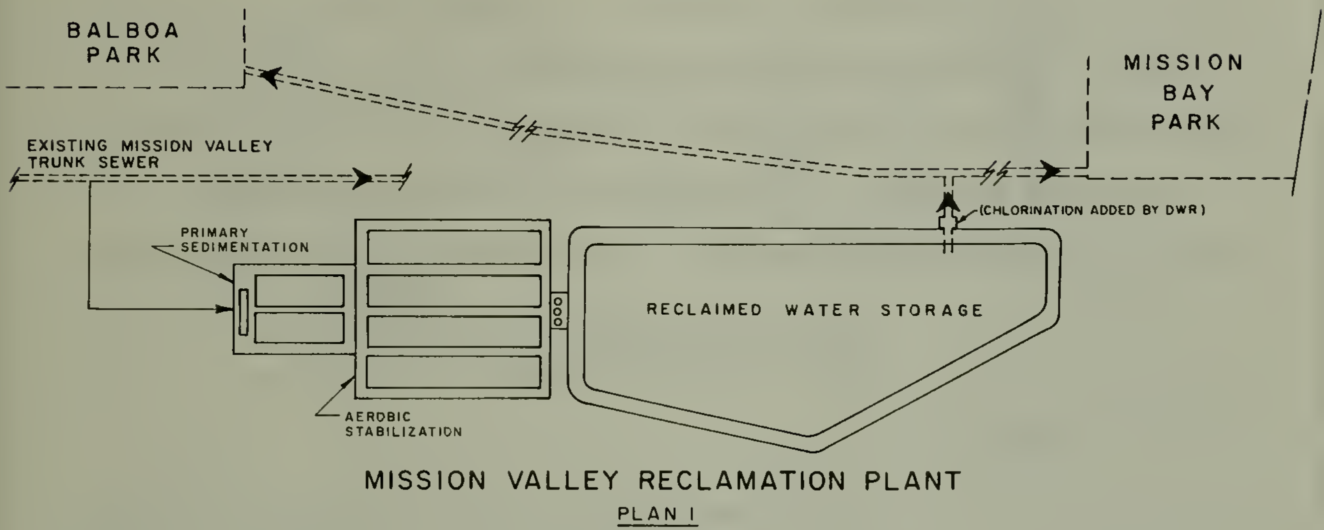


Figure 20-PROPOSED WASTE WATER RECLAMATION PLANTS LOCATIONS AND POTENTIAL USES IN THE SAN DIEGO METROPOLITAN SUBAREA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1967

of $3,498,000, would be located in Mission Valley to serve both parks, Balboa and Mission Bay. The cost includes reclaimed water production facilities, storage facilities, and transmission and main distribution facilities for both parks. Variations considered in plan 1 resulted in cost estimates ranging from $3,335,000 to $3,552,000.

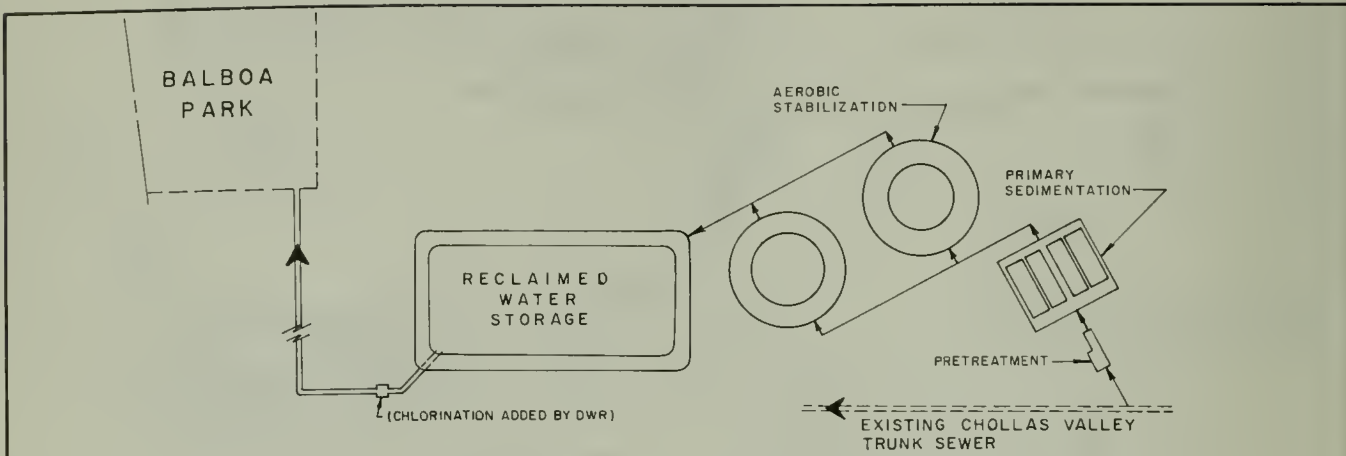


NOTE: FLOW DIAGRAMS OBTAINED FROM THE "CITY OF SAN DIEGO WATER RECLAMATION STUDY FOR BALBOA PARK AND MISSION BAY PARK" BY BOYLE ENGINEERING.

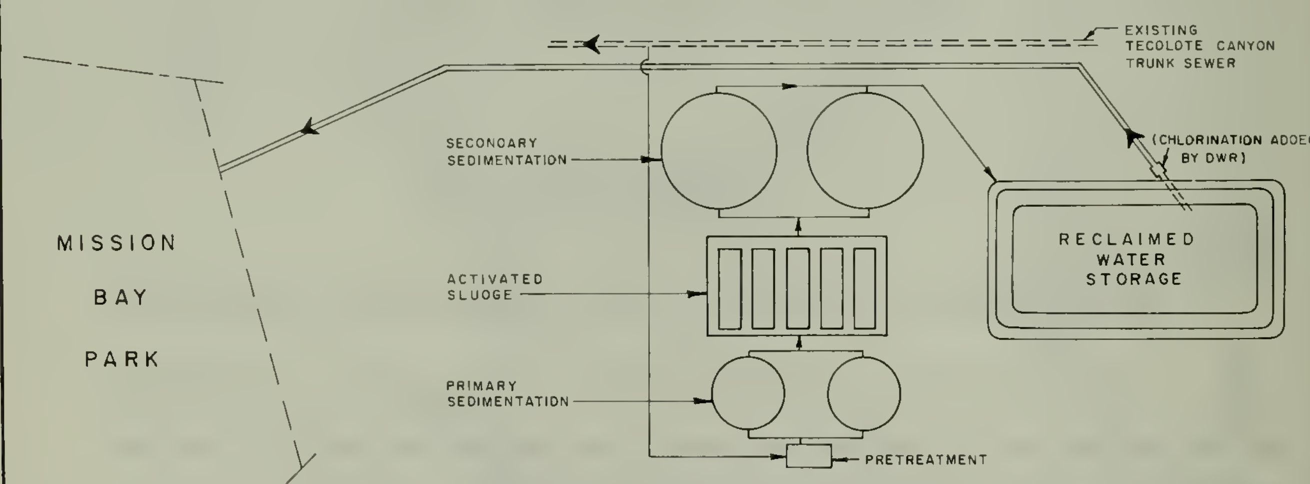
Figure 21-FLOW DIAGRAM FOR PROPOSED CLASS A RECLAMATION PLANT AT MISSION VALLEY

Plan 2 calls for a separate system for each park. The Tecolote Valley system for Mission Bay Park would cost $2,205,000, and the Chollas Valley system for Balboa Park would cost $1,800,000. Location of plants for both plan 1 and plan 2 is shown in Figure 20. Flow diagrams for both plants are shown in Figures 21 and 22.

Costs, projected over a 40-year amortization period at 4 percent interest for structures and pipelines, and over a 20-year period at 4 percent for mechanical equipment, varied from $43 to $45 per acre-foot for plan 1 and from $52 to $53 per acre-foot for plan 2.



CHOLLAS VALLEY RECLAMATION PLANT
PLAN 2



TECOLOTE VALLEY RECLAMATION PLANT
PLAN 2

NOTE FLOW DIAGRAMS OBTAINED FROM THE "CITY OF SAN DIEGO WATER RECLAMATION STUDY FOR BALBOA PARK AND MISSION BAY PARK" BY BOYLE ENGINEERING.

Figure 22-FLOW DIAGRAMS FOR PROPOSED CLASS A RECLAMATION PLANTS AT TECOLOTE AND CHOLLAS VALLEYS

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1967

The Santee County Water District in 1966 began construction of a new activated sludge-type treatment plant complex designed to treat a maximum of 4 million gallons of waste water per day. The new plant is located about 3 miles upstream from the existing facilities in Sycamore Canyon. The plant was placed in operation in December 1967.

Part of the new complex will contain a pilot plant to demonstrate the feasibility of demineralizing waste water for additional beneficial purposes. This pilot plant will be able to produce waters of various qualities to meet various types of water usages. This new plant should be in operation by the latter part of 1968.

The method of operation employed by the District in the conventional plant is to direct the flow of effluent into two oxidation ponds operated in parallel, and then through 400 feet of soil and chlorination facilities before it enters a series of nine recreational lakes. One method of operation will be to set aside Lakes 1, 2, 7, and 9 for boating and fishing, with picnicking along the shores of the lakes; Lake 3 would be used for quiet fishing; Lake 4 for sailing and fishing; Lake 5 for paddle boats, picnicking, and fishing; Lake 6 for boating, with broad lawn areas adjacent to the lake to be used for outdoor sports; Lake 7 for boating and fishing, with the adjacent areas set aside for overnight camping; Lake 8 for water skiing. The recreational activities of each lake are operated and changed to suit seasonal demand for the various activities.

The District reports it has developed markets to sell its reclaimed water for irrigation uses at a retail price of $40 per acre-foot, which is approximately 1/4 of the current retail price of water in the area. The system will be placed in operation in March 1968. Irrigation uses already planned include another golf course in addition to the one now being served, a 200-acre tree farm, a 130-acre college campus, a high school campus, highway and institutional landscaping, and selected crops.

In addition, a collective effort by the District, the Rio Municipal Water District, the City of San Diego, and Helix Irrigation District is already under way to initiate a plan to manage the ground water basin using reclaimed water, potable water, and brackish waters in the San Diego River and Sycamore Canyon areas.

San Diego County Subarea

The proposal has been made that 1 mgd of Escondido's waste water effluent be diverted from Escondido Creek to San Dieguito River to aid in inhibiting sea-water intrusion. This reclaimed water would cost from $11 to $22 per acre-foot, depending on the method of transport.

A new activated sludge waste water treatment facility is now being designed to serve the southern portion of the City of Escondido. The new plant will be a class A reclamation facility, with all sludge being pumped to the existing treatment plant. Effluent from the plant is to be used for irrigation of a 90-acre golf course, and to serve future park and landscaped areas along U. S. Highway 395. The design for the system will provide for pumping all flows in excess of the irrigation requirement to the existing plant.

Waste water reclamation and reuse has been proposed by the San Diego County's Special District Services for Jamacha Valley, and by the Otay Municipal Water District for its own service area.

The Fallbrook Sanitary District has completed plans to use reclaimed water from the existing treatment plant for irrigation at the Fallbrook Airpark and possible golf course adjacent to the treatment plant.

The Valley Center Municipal Water District, Improvement District U-6, now has a 0.1 mgd activated sludge contact stabilization treatment plant under construction. Plant facilities include effluent pumps for irrigating the existing golf course.

Potential Waste Water Reclamation Projects

Potential waste water reclamation projects are limited, in this report, to the San Diego metropolitan subarea only, because this is the only one of the three subareas from which large quantities of waste water are discharged to the ocean.

Potential class A planned reclamation projects considered here are irrigation of golf courses, parks, and scenic freeways in the San Diego metropolitan subarea [21,22,23]. A list of selected potential projects with the estimated yearly irrigation water demand is given in Table 19.

Some of the areas where potential class A waste water reclamation systems may be considered are El Cajon, Mission Gorge, Rose Canyon, and Spring Valley. El Cajon and the Spring Valley Sanitation District have existing waste water treatment plants suitable for reclamation. These plants have been abandoned because of connection with the San Diego Metropolitan Sewerage System. While they were in operation, effluent from the two plants was being used to irrigate golf courses and a ballpark.

TABLE 19

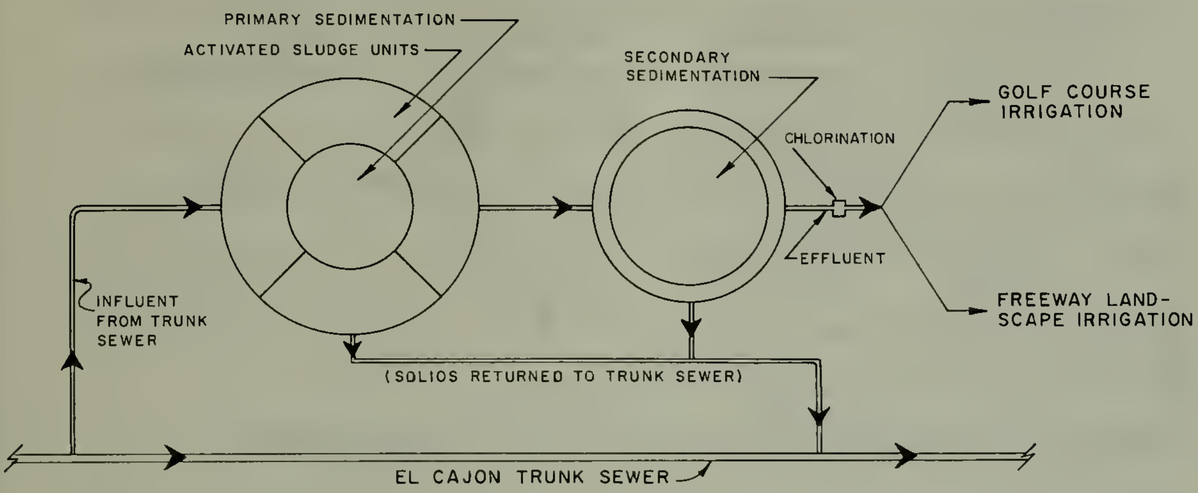
SELECTED POTENTIAL PROJECTS USING RECLAIMED WATER

Location	Use	Amount in acre-feet per year
El Cajon	Golf course	375
	Freeway landscaping	330
Mission Gorge	Park	900
Rose Canyon	Golf course	375
	Freeway landscaping	300
	Park	900
Spring Valley	Golf courses	600
TOTAL		3,780

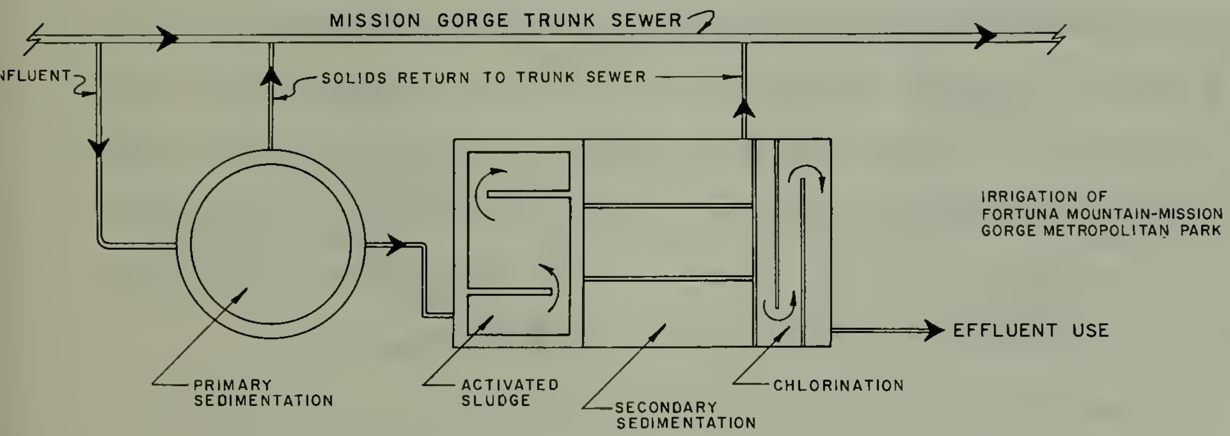
A plant could be constructed in Mission Gorge to irrigate part of the Fortuna Mountain-Mission Gorge Metropolitan Park. In the Rose Canyon area, a plant could be constructed to irrigate a future golf course, future park, and future scenic freeways. Flow diagrams of these plants are shown on Figure 23 and Figure 24.

El Cajon Waste Water Reclamation Plant

El Cajon's waste water treatment plant, with a design capacity of 2.8 mgd, can produce irrigation water at an average daily rate of 1.7 mgd. At present, the Fletcher Hills Golf Course has an average demand of about 0.34 mgd. The State Division of Highways has an average daily demand of about 0.30 mgd for freeway landscaping in the El Cajon-La Mesa area.



EL CAJON WATER RECLAMATION PLANT

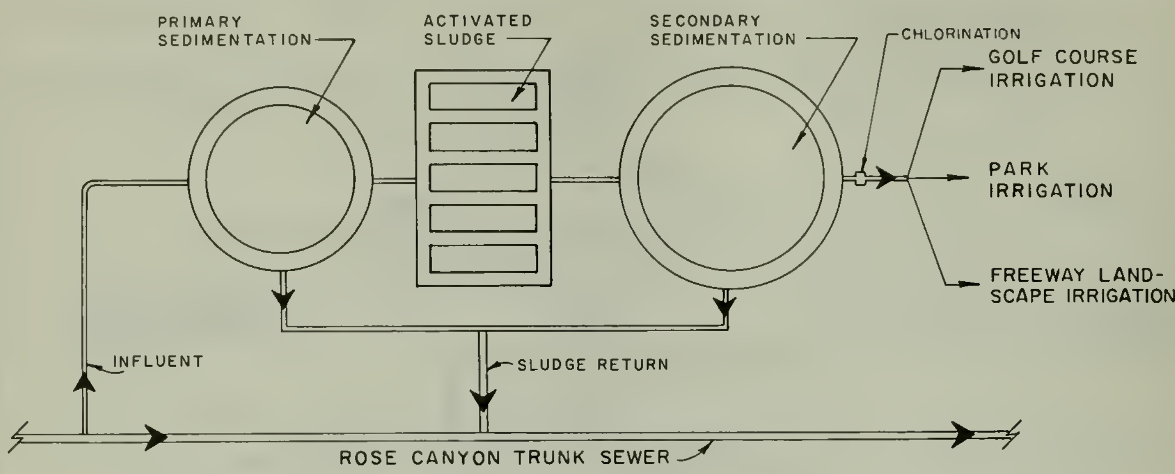


MISSION GORGE WATER RECLAMATION PLANT

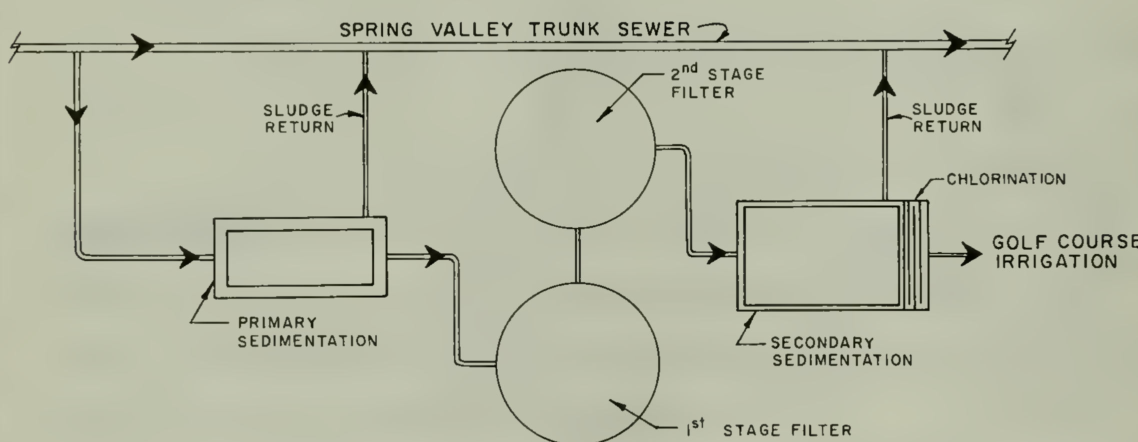
NOTE: EXISTING TRUNK SEWERS ARE CONNECTED TO THE SAN DIEGO METROPOLITAN SEWERAGE SYSTEM WITH FINAL TREATMENT AND DISPOSAL AT THE POINT LOMA SEWAGE TREATMENT PLANT.

Figure 23-FLOW DIAGRAMS FOR POTENTIAL CLASS A PLANNED WASTE WATER RECLAMATION PLANTS IN THE METROPOLITAN SUBAREA

PARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1967



ROSE CANYON WATER RECLAMATION PLANT



SPRING VALLEY WATER RECLAMATION PLANT

NOTE: EXISTING TRUNK SEWERS ARE CONNECTED TO THE SAN DIEGO METROPOLITAN SEWERAGE SYSTEM WITH FINAL TREATMENT AND DISPOSAL AT THE POINT LOMA SEWAGE TREATMENT PLANT.

Figure 24-FLOW DIAGRAMS FOR POTENTIAL CLASS A PLANNED WASTE WATER RECLAMATION PLANTS IN THE METROPOLITAN SUBAREA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1967

Using an irrigation demand of 0.64 mgd, Figure 16 indicates that operational costs for the El Cajon plant would be approximately $23 per acre-foot of reclaimed water. There are no capital costs chargeable to reclamation as the existing facilities could be used at any time. The net cost of reclamation over and above average disposal costs of $14 per acre-foot paid to the City of San Diego would be $9 per acre-foot. Costs of disposal will be incurred whether reclamation is practiced or not. If a market could be found for a total of 1.7 mgd, the costs of reclaiming water at the plant site would drop from $23 to $18 per acre-foot. A flow diagram of the plant is shown in Figure 23.

<u>Mission Gorge Waste Water Reclamation Plant</u>

A waste water reclamation plant could be constructed to supply all or part of the irrigation requirements of the Fortuna Mountain-Mission Gorge Metropolitan Park in the Mission Gorge area. The waste water may be taken from the Mission Gorge trunk sewer if this water is of sufficient quantity and quality. This sewer was not in operation during the field sampling.

An estimated irrigation requirement of 900 acre-feet per year, or 0.8 mgd, may be needed for Mission Gorge Park at present, and more may be needed in the future. Waste water may also be used for recreational lakes in the park area. A plant producing treated waste water for an irrigation demand of 1.0 mgd could be constructed at the park site to eliminate transmission lines. This plant would require a design flow of 1.65 mgd to allow for peak irrigation demand. It could be operated for about $65 per acre-foot to provide reclaimed water for park irrigation. If other uses of the treated waste water could be found for continuous operation of the plant at design flow, the cost would be reduced to about $45 per acre-foot. The net cost of reclamation over and above the $14 per acre-foot average disposal costs would be $51 per acre-foot for the 1.0 mgd plant, and $31 per acre-foot for the 1.65 mgd plant. The approximate location of the plant is shown in Figure 20, and a flow diagram is shown in Figure 23.

<u>Rose Canyon Waste Water Reclamation Plant</u>

A water reclamation plant could be installed to satisfy irrigation requirements for a future golf course in Rose Canyon, a future park in San Clemente Canyon, and future freeway landscaping. The waste water may be taken from the Rose Canyon trunk sewer, which now has an average daily summer flow of about 2 mgd.

Irrigation requirements for the Rose Canyon area are estimated to be about 375 acre-feet per year for the golf course, 900 acre-feet per year for the park, and 300 acre-feet per year for freeway landscaping. This amounts to an average demand of about 1.4 mgd, with peak summer demands of 2.3 mgd. Flow volume in the Rose Canyon sewer is not yet sufficient to meet the irrigation demand, but the volume should be ample by the time the area is developed.

A reclamation plant to satisfy a 1.4 mgd irrigation demand could be constructed and operated for about $60 per acre-foot. For 2.3 mgd of reclaimed water, the cost would be reduced to $42 per acre-foot. The net cost of reclamation over and above the $14 per acre-foot average disposal costs would be $46 per acre-foot for the 1.4 mgd plant and $28 per acre-foot for the 2.3 mgd plant. The location of this plant is shown in Figure 20 and a flow diagram in Figure 24.

Spring Valley Waste Water Reclamation Plant

The Spring Valley Sanitation District has abandoned its 1 mgd waste water treatment plant and has connected to the San Diego Metropolitan Sewerage System. During the 1962-63 fiscal year, the flow through the Spring Valley Sanitation District plant was 1.71 mgd of marginal quality waste water.

Population growth will require additional facilities for waste water disposal. In lieu of building additional sewers, the existing plant could be reactivated as a class A system.

Bonita Valley Country Club, an 18-hole golf course, and Bonita Golf Course, a 9-hole golf course, are located in Sweetwater River Valley below the Spring Valley Sewage Treatment Plant. The 18-hole course requires about 400 acre-feet per year and the 9-hole course about 200 acre-feet per year. Irrigation demand for both courses would average about 0.54 mgd.

Based on Figure 16, operation costs at the Spring Valley plant site would be about $25 per acre-foot for 0.54 mgd of reclaimed water. There are no capital costs chargeable to reclamation as the existing facilities could be used. The net cost of reclamation over and above average disposal costs of $14 per acre-foot paid to the City of San Diego would be $11 per acre-foot.

The location of the proposed system is shown in Figure 20 and flow diagram is shown in Figure 24.

CHAPTER VI. SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The principal results of this investigation are summarized in the following findings, conclusions, and recommendations.

Summary of Findings

The findings of this investigation may be summarized as follows:

1. Surface and ground water resources in coastal San Diego County are not adequate to meet the current water demand. Therefore, water is also supplied from the Colorado River and from waste water reclamation. Approximately 90 percent of the water used in 1965-66 was from the Colorado River. It is anticipated that water requirements by the year 2000 will double the quantity now used. For the future supply, all present sources will be used, and water will also be imported from Northern California through the State Water Project, now under construction, and existing facilities of The Metropolitan Water District of Southern California, and the facilities of the San Diego County Water Authority.

2. The beneficial uses of water in coastal San Diego County are domestic consumption; municipal use; commercial use; industrial use; and irrigation of agricultural lands, golf courses, parks, and freeway landscaping.

3. A total of 44 major waste disposal systems are in operation in coastal San Diego County. Of these, 12 are in Camp Pendleton Marine Corps Base (called Camp Pendleton subarea in the report), 5 are in the area served by the San Diego Metropolitan Sewerage System (San Diego

metropolitan subarea), and 27 are in the remainder of coastal San Diego County (San Diego County subarea).

4. In the 1962-63 fiscal year, about 72 million gallons per day of waste water were produced, and in 1965-1966, 86 mgd were produced in coastal San Diego County. Of this amount, more than 59 mgd in 1962-63, and 70 mgd in 1965-66, came from the metropolitan subarea; 8.9 mgd in 1962-63 and 10.1 in 1965-66 from the county subarea; and the remainder from the Camp Pendleton subarea.

5. Of the 72 mgd of waste water discharged in the study area in 1962-63, approximately 73 percent, or 54 mgd, was discharged to the ocean. In 1965-66, 86 mgd were discharged in the study area, of which 85 percent, or 72 mgd, was discharged to the ocean.

6. At all but three discharge sites in the county and Camp Pendleton subareas, reclamation of some kind occurs. In most cases, it is "involuntary reclamation", with waste water mingling with water from other sources, as in lakes, streams, or ground water basins. It is used for such purposes as irrigation, ground water recharge for eventual application to beneficial uses, and scenic and recreational lakes.

7. Waste water flows in the study area consist of domestic wastes, industrial wastes, and water contributed to the sewerage system through infiltration.

8. The study substantiated earlier findings that the mineral quality of the water supply is the most significant factor in determining the quality of the waste water. Also contributing to this quality are the mineral pickup resulting from domestic and industrial uses and the quality and quantity of infiltration waters.

9. Colorado River water is very hard and is between Class 1 and Class 2 as irrigation water. The local ground water supply is also very hard and is from Class 2 to Class 3 as irrigation water. The local surface water is moderately hard and is Class 1 as irrigation water.

10. In 1962-63, approximately 41.2 mgd of waste water in the San Diego metropolitan subarea, of which 40 mgd were discharged to the ocean, were of a quality that is generally classified as marginal for reclamation and reuse. About 8.3 mgd of the waste water in the county subarea and 3 mgd of that in Camp Pendleton subarea are also classified as marginal. This class of water can be beneficially used for irrigation of golf courses, parks, green belts, and selected crops, and for recreational lakes and industrial purposes.

11. The numerous waste water reclamation plants in coastal San Diego County reclaimed about 18,000 acre-feet in 1962-63, and 15,000 acre-feet in 1965-66, for various beneficial uses.

12. The City of San Diego pays approximately $50 per acre-foot for Colorado River water. This includes payment of taxes to The Metropolitan Water District of Southern California.

13. In the San Diego metropolitan area, consumer costs for water vary from about $90 to $150 per acre-foot.

14. There are several proposed waste water reclamation projects in coastal San Diego County. A summary of some of the proposed projects is as follows:

Project	Plant capacity in mgd	Cost per acre-foot at point of use	Beneficial uses
Escondido	1.0	$11-22	Ground water recharge*
Mission Valley	10.0	43-45	Irrigation of green belts
Santee	4.0	40	Golf course, tree farm, landscape, and selected crop irrigation
Tecolote and Chollas Valleys	10.0	52-53	Irrigation of green belts

*Underground storage by artificial recharge is a beneficial use if the water is later used.

15. There are several potential waste water reclamation projects in the metropolitan subarea. A summary of these is presented below.

Project	Plant capacity in mgd	Net cost per acre-foot at plant site	Beneficial uses
El Cajon	0.64 1.7	$ 9 4	Golf course and freeway landscape irrigation
Mission Gorge	1.0 1.65	51 31	Park irrigation Park irrigation
Rose Canyon	1.4 2.3	46 30	Golf course, park and freeway landscape irrigation
Spring Valley	0.54	11	Golf course irrigation

These costs do not include those related to the benefits or detriments associated with nutrient value, but they do include a credit for waste disposal amounting to $14 per acre-foot.

Conclusions

As a result of this investigation, the following conclusions were reached:

1. Because waste water discharged to the ocean is considered lost for beneficial uses, reclamation of this waste water would offer a new source of supply.

2. From the findings in this report, it appears that coastal San Diego County offers a market for reclaimed waste water and has sufficient waste water of acceptable quality for reclamation. The present water agencies have adequate legal protection to undertake reclamation, and the cost of reclaimed water in many areas would be competitive with, or less than, the cost of present and future imported supplies. Thus, reclamation of waste water in coastal San Diego County is feasible; however, more detailed studies are required to establish the economic justification of each potential reclamation system.

3. The metropolitan subarea is the major area from which waste water is being discharged to the ocean, and in which the largest supply of waste water is available and the greatest demand for water exists. It is, therefore, the subarea in which additional waste water reclamation projects appear to be most desirable.

4. The addition of Northern California water to future supplies will upgrade the quality of the waste water in coastal San Diego County.

5. Reclaimed waste water in the San Diego coastal area may be used for ground water recharge, recreational lakes, gravel-washing, road construction, industrial purposes, and irrigation of the following: selected crops, recreational areas, golf courses, parks, cemeteries, and scenic freeways.

6. Specific waste water reclamation projects that may be considered include a plant in the El Cajon-La Mesa area to supply irrigation water for a golf course and freeway landscaping; in the Mission Gorge area to supply irrigation water for a park; in the Rose Canyon area to supply irrigation water for a golf course, park, and freeway landscaping; and in the Spring Valley area to supply irrigation water for golf courses. In two of these areas -- El Cajon and Spring Valley -- abandoned treatment plants are available for conversion to these uses. The Santee Waste Water Reclamation Plant, which is already in existence, is being enlarged to supply the needs in the El Cajon area.

7. Implementation of major waste water reclamation projects in the study area could postpone construction of additional importation facilities.

Recommendations

On the basis of these findings and conclusions, the following recommendations are offered:

1. Waste water reclamation in the San Diego coastal area should be initiated or increased, where economically justified, to meet a portion of the future water requirements.

2. Sewage treatment plants that have been abandoned because of the completion of the San Diego Metropolitan Sewerage System should be considered potential waste water reclamation plants.

APPENDIXES

APPENDIX A

SELECTED REFERENCES

USED IN THIS INVESTIGATION

APPENDIX A

SELECTED REFERENCES USED IN THIS INVESTIGATION*

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APPENDIX B

DEFINITIONS OF TERMS

APPENDIX B

DEFINITIONS OF TERMS

Specialized words and terms used in this report are defined below. They are based on the "Glossary of Water and Sewage Control Engineering", 1949, published by the American Society of Civil Engineers.

Aeration - The bringing about of intimate contact between air and a liquid by one of the following methods: Spraying the liquid in the air, bubbling air through the liquid, or agitating the liquid to promote absorption of air.

Clarifier - A tank or basin in which water, sewage, or other liquid containing settleable solids is retained for a sufficient time so that a part of the suspended matter is removed by gravity. Usually in waste water treatment, the detention period is short enough to avoid anaerobic decomposition. Also termed settling tank.

Comminutor (Also Barminutor) - A device for the cutting of coarse sewage solids into particles of sufficient fineness to pass through fine screen openings.

Complete Mineral Analysis - A determination of the concentration of the principal dissolved constituents of water (calcium, magnesium, sodium, potassium, hydroxide, bicarbonate, carbonate, chloride, sulfate, nitrate, boron, and fluoride). Such an analysis includes determinations of total dissolved solids, electrical conductance, and pH.

Complete Waste Water Treatment - Combined sedimentation and biological treatment of waste water which produces a clear, stable, and well-oxidized effluent.

Detritor - A settling tank of short detention period designed to remove heavy settleable solids such as sand or gravel.

Digester - A tank in which the solids resulting from the sedimentation of sewage are stored for anaerobic decomposition.

Electrical Conductance - The reciprocal of the resistance in ohms measured between opposite faces of a centimeter cube of an aqueous solution at a temperature of 25° centigrade. This is generally expressed in micromhos/cm.

Imhoff Tank - A deep, two-storied sewage tank consisting of an upper or continuous flow sedimentation chamber and a lower or sludge-digestion chamber.

Incidental Reclamation - A process wherein the recovery of waste waters for beneficial use is secondary to waste water treatment or disposal.

Industrial Waste - Defined in Section 13005 of the California Water Code as "... any and all liquid or solid waste substance, not sewage, from any producing, manufacturing or processing operation of whatever nature".

Involuntary Reclamation - The recovery for beneficial use of waste waters that have lost their identity through mixing with natural streamflow or ground water to which they were discharged.

Oxidation Pond - An artificial pond that provides an environment for living organisms, which, in the presence of oxygen, convert the organic matter contained in waste water to a more stable form.

pH - The logarithm, to the base 10, of the reciprocal of the hydrogen ion concentration, or more precisely, of the hydrogen ion activity in moles per liter.

Parshall Flume - A device for measuring the flow of liquid in an open conduit.

Planned Reclamation - Any process of recovery of water from waste waters that was originally planned and conceived for the primary purpose of putting the recovered water to beneficial uses.

Primary Waste Water Treatment - Any process that removes a portion of the settleable suspended and floating matter from domestic or industrial waste by screening, skimming, sedimentation, or other physical means.

Reclamation - The process of recovering water from domestic or industrial wastes so that the water may be put to beneficial use.

Safe Yield - The maximum dependable draft which can be made continuously upon a source of water supply (surface or ground water) during a period of years during which the probable driest period or period of greatest deficiency in water supply is likely to occur. Dependability is relative and is a function of storage provided and drought probability.

Secondary Waste Water Treatment - Any process of domestic or industrial waste treatment that may or may not follow primary treatment, and that accomplishes stabilization of organic matter by biological or chemical action.

Sewage - Defined in Section 13005 of the California Water Code as ". . . any and all waste substance, liquid or solid, associated with human habitation, or which contains or may be contaminated with human or animal excreta or excrement, offal, or any feculent matter".

Trickling Filter - A bio-filter contact chamber consisting of coarse material, such as stones, over which waste water is distributed, and through which it trickles, giving opportunity for the formation of zoogleal slimes which clarify and oxidize the waste water.

Waste Water - Water that has been put to some use or uses and has been disposed of commonly to a sewer or wasteway. It may be industrial liquid waste, or sewage, or both.

Water Requirement - The water needed to provide for all beneficial uses, whether consumptive or nonconsumptive, and for irrecoverable losses incidental to such uses.

APPENDIX C

DESCRIPTION OF WASTE WATER TREATMENT

PLANTS IN COASTAL SAN DIEGO COUNTY

APPENDIX C

DESCRIPTION OF WASTE WATER TREATMENT PLANTS IN COASTAL SAN DIEGO COUNTY

A general description of the larger waste water treatment plants in the study area, except for the San Diego Point Loma Treatment Plant, is given in this appendix. The Point Loma Treatment Plant is described in Chapter III. The descriptions include the degree of treatment practiced, number and type of units used to achieve that treatment, design capacity, actual flows handled, and point of disposal of the effluent.

For convenience, the plants are divided according to the three subareas: San Diego metropolitan subarea, San Diego County subarea, and Camp Pendleton subarea. The metropolitan subarea and the county subarea are further divided into plants that are now operational and plants that have been abandoned.

San Diego Metropolitan Subarea

Five sewage treatment facilities in the San Diego metropolitan subarea are now in operation and nine have been abandoned. Four of the operational facilities and all those abandoned are described here.

Operational Facilities

The five facilities currently in operation in 1967 are the Lakeside, Santee, Brown and Ream Fields, and Point Loma Waste Water Treatment Plants. The Point Loma Plant is described in Chapter III. The other four are discussed here.

Lakeside Waste Water Treatment Plant. The Lakeside Waste Water Treatment Plant is a secondary treatment plant with an ultimate design capacity of 2.1 million gallons per day (mgd). The average daily flow during 1965-66 was 0.29 mgd. The plant, which is operated by the Lakeside Sanitation District, consists of a wet well, comminutor, Parshall flume, rectangular primary clarifier, mixing tank, secondary clarifier, reaeration tank, aerobic digester, 15,300 cubic feet of an anaerobic digester, sludge lagoon aeration, and 12,500 square feet of sludge-drying beds. The final effluent is discharged into three percolation beds in the San Diego River.

Santee Waste Water Reclamation Plant. The Santee Reclamation Plant, which is operated by the Santee County Water District, provides secondary treatment for approximately 1.2 mgd. The plant consists of a barminutor, clarifier, activated sludge unit, floating cover digester, oxidation pond, and sludge-drying beds. The effluent from the oxidation pond is pumped to a percolation area where it is collected; at that point it is chlorinated and then flows to four lakes operated in series. The final effluent is discharged to Sycamore Canyon Creek.

Brown Field Waste Water Treatment Plant. The Brown Field Waste Water Treatment Plant, now under jurisdiction of the City of San Diego, is a secondary treatment facility with a design capacity of 0.22 mgd. The plant consists of a comminutor, primary Imhoff tank, trickling filter, secondary Imhoff tank, Parshall flume, chlorination facilities, and two sludge drying beds. The final effluent discharges into sand filter beds that overflow into a dry wash tributary to Tia Juana River.

Ream Field Waste Water Treatment Plant. The Ream Field Waste Water Treatment Plant, serving the U. S. Naval Auxiliary Air Station, has a design capacity of 0.45 mgd. The plant provides primary treatment with equipment consisting of a comminutor, primary clarifier, Parshall flume, chlorine contact tank, sludge digester, and four sludge drying beds. During operation, the final effluent is discharged into the Tia Juana River.

Abandoned Facilities

The sewage treatment facilities in the San Diego metropolitan subarea that have been abandoned are described below.

Camp Elliot Waste Water Treatment Plant. The Camp Elliot Waste Water Treatment Plant, operated by the U. S. Navy, was abandoned on October 1, 1960. Prior to abandonment, the plant served the Camp Elliot Naval Reservation. The plant, which provided secondary treatment, has a design capacity of 2.0 mgd. The plant consists of two comminutors, two primary clarifiers, two primary high-rate trickling filters, a secondary filter, two secondary clarifiers, chlorination equipment, a Parshall flume, a chlorine contact chamber, two separate sludge digesters, and six sludge drying beds. During operation, the final effluent was discharged into a dry wash tributary to Murphy Canyon.

Chula Vista Sewage Treatment Plants. Chula Vista has two sewage treatment plants. The "G" Street plant is a primary treatment facility with a design capacity of 0.3 mgd. The average flow through the plant for 1962-63 fiscal year was 0.49 mgd. The plant consists of an Imhoff tank, a separate sludge digestion unit, and chlorination equipment. The final effluent was discharged to San Diego Bay through an outfall sewer.

The "J" Street plant is a primary treatment facility with a design capacity of 1.4 mgd. The average flow handled by the plant for the 1962-63 fiscal year was 2.69 mgd. The plant consists of a bar screen, lift pumps, two circular combination aeration-sedimentation tanks, a separate sludge digestion unit and drying beds, chlorination equipment, and a propellor-type meter with recorder. The final effluent was discharged into San Diego Bay.

The City of Chula Vista has been connected to the San Diego Metropolitan Sewerage System since September 1963. Plans are that the treatment plants will be destroyed.

Coronado Sewer Outfalls. The Coronado sewerage system consists of two outfalls to San Diego Bay. The "B" Street outfall has a design capacity of 1.73 mgd and the "K" Street outfall has a design capacity of 3.46 mgd.

Since September 1963, the Coronado sewerage system has been connected to the San Diego Metropolitan Sewerage System and the outfalls abandoned.

El Cajon Sewage Treatment Plant. The El Cajon Sewage Treatment Plant was designed to provide secondary treatment for a capacity of 2.8 mgd. The average daily flow handled by the plant for the fiscal year 1961-62 was 2.17 mgd and for the 1962-63 fiscal year was 2.51 mgd. The plant consists of a primary clarifier, which includes an annular outer aeration chamber that is divided into preaeration, aeration, and reaeration sections, a secondary clarifier, two separate digesters with sludge drying beds, chlorination equipment, a chlorine contact tank, and a flow meter. The final effluent was discharged to Forrester Creek, with approximately 0.5 mgd being used for irrigation of the Fletcher Hills golf course and 0.07 mgd for a ball park.

The City of El Cajon connected to the San Diego Metropolitan Sewerage System in September 1963 and the treatment plant was shut down. Plans include an economic study to determine the possibility of reactivating the plant as a waste water reclamation plant.

<u>Gillespie Field Sewage Treatment Plant</u>. The Gillespie Field Sewage Treatment Plant, operated by Gillespie Field Sanitation District, is a secondary treatment facility with a design capacity of 0.25 mgd. The treatment plant was built to handle flows from Gillespie Field only, and in 1961-62 had an average daily flow of 0.04 mgd. The plant consists of a comminutor, primary clarifier, filter, secondary clarifier, separate sludge digester and sludge drying beds, Parshall flume, chlorination facilities, and percolation beds. The final effluent was discharged to a drainage ditch which flows into Forrester Creek.

As of September 1, 1963, the waste water flows from Gillespie Field were transported to the Metropolitan Sewerage System and the plant abandoned.

<u>Imperial Beach Sewage Treatment Plant</u>. The Imperial Beach Sewage Treatment Plant has a design capacity of 0.45 mgd. The plant afforded secondary treatment at an average flow of 0.85 mgd during the

1960-61 fiscal year. The plant consists of an Imhoff tank, trickling filter, a secondary clarifier, a Parshall flume, two oxidation ponds, and eight sludge drying beds. Disposal of the final effluent was normally by evaporation and percolation from a lagoon.

As of September 1, 1963, the Imperial Beach sewage system has been connected to the San Diego Metropolitan Sewerage System, and the sewage treatment plant has been abandoned and, according to information at hand, will be destroyed.

International Sewer Outfall. The International Sewer Outfall, which was under jurisdiction of the International Boundary and Water Commission, was sealed and abandoned on July 10, 1962. Prior to its abandonment, the outfall transported sewage from Tijuana (Baja California) and San Ysidro (California) to the Pacific Ocean at the mouth of the Tia Juana River. The average flow during the 1960-61 fiscal year was 3.8 mgd and for the 1961-62 fiscal year was 1.92 mgd.

Palm City Waste Water Treatment Plant. The Palm City Waste Water Treatment Plant, operated by Palm City Sanitation District, is a secondary treatment facility with a design capacity of 1.70 mgd. The plant consists of a barminutor, Parshall flume, primary clarifier, high-rate trickling filter, secondary clarifier, separate sludge digestion unit, and three oxidation ponds. The final effluent was discharged into the Otay River.

Palm City has been connected to the San Diego Metropolitan Sewerage System since September 1963. Plans indicate that the Palm City Waste Water Treatment Plant will be destroyed.

San Diego Harbor Drive Waste Water Treatment Plant. The Harbor Drive Plant (Bay Plant) was a primary treatment plant with a design capacity of 40 mgd. The plant, which was operated by the City of San Diego, consists of a mechanical bar screen, four raw sewage pumps, two combined aeration-sedimentation tanks with each aeration unit containing a detritor and grit chamber, chlorination facilities, four heated primary digesters, and two heated secondary digesters. The digested sludge was transported to Mission Bay Park and the final effluent was discharged to San Diego Bay.

San Ysidro. The San Ysidro Waste Water Treatment Plant consisted of a pumping station, chlorination facilities, and a raw sewage lagoon. The final effluent percolated into the bed of the Tia Juana River. The daily flow for the 1965-66 fiscal year was 0.18 mgd.

Operation of the plant for the San Ysidro Sanitation District was taken over by the City of San Diego on July 1, 1962. San Ysidro was connected to the San Diego Metropolitan Sewerage System during February 1966.

Spring Valley Waste Water Treatment Plant. The Spring Valley Sewage Treatment Plant was a secondary treatment facility with a design capacity of 1.0 mgd. The average flow for the 1962-63 fiscal year was 1.71 mgd. The plant consists of a barminutor, Parshall flume, primary clarifier, separate sludge digester, two high-rate trickling filters, and secondary clarifier. The final effluent was chlorinated, discharged to Sweetwater Creek, and subsequently used to irrigate a golf course.

The Spring Valley Sanitation District connected its sewerage system to the San Diego Metropolitan Sewerage System on September 1, 1963, and the treatment plant was abandoned.

San Diego County Subarea Operational Facilities

Alpine Waste Water Treatment Plant

The Alpine Waste Water Treatment Plant is an intermediate treatment facility operated by the Alpine Sanitation District. The plant has a design capacity of 0.07 mgd, and during the 1965-66 fiscal year, handled an average flow of 0.03 mgd. The facility consists of a bar screen, primary clarigester unit which combines sedimentation and digestion, and oxidation ponds in series. Final discharge of the effluent is to Alpine Creek.

Possible expansion of the sewerage system is being studied by the San Diego County Department of Special District Services.

Callan Waste Water Treatment Plant

The Callan Waste Water Treatment Plant, operated by the City of San Diego, serves the La Jolla Farms subdivision. Torrey Pines Golf Course and Inn, General Atomic Division of General Dynamics, and the Salk Institute for Biological Studies. The plant flows averaged 0.48 mgd during the 1965-66 fiscal year; the effluent was used to irrigate the grounds of the laboratory of the General Atomic Division. The facility provides intermediate treatment in the form of oxidation ponds plus chlorination. The design capacity of the plant is 1.0 mgd.

Del Mar Waste Water Treatment Plant

The Del Mar Waste Water Treatment Plant, which is operated by Del Mar Utilities, is a secondary treatment facility with a design capacity of 0.25 mgd. The plant consists of an influent pumping station, primary aeration-sedimentation tank, sludge digester, a chlorine contact chamber, and three oxidation ponds. The final effluent is discharged into the San Dieguito River. During the 1965-66 fiscal year, the plant treated and disposed of an average flow of 0.22 mgd. No plans for the future have yet been made.

Encina Waste Water Treatment Plant

The Encina Water Pollution Control Facility provides primary treatment and disposal facilities for Buena Vista and Vista Sanitation Districts and for the City of Carlsbad. The plant began operations on September 5, 1965, and is designed to treat a maximum 4.5 mgd. During the 1965-66 fiscal year, the average daily flow was 1.7 mgd. Facilities include flow meter, prechlorination, bar screen, grit remover, primary sedimentation tanks, primary and secondary sludge digesters and sludge drying beds. Final disposal of the primary effluent is through a 5,500-foot ocean outfall. San Marcos County Water District has approved a bond issue to connect to the Encina plant. The plant is operated by the San Diego County Department of Special District Services.

Encinitas Waste Water Treatment Plant

The Encinitas Waste Water Treatment Plant is a secondary treatment facility operated by the Encinitas Sanitary District. The plant has a design capacity of 0.25 mgd, and the average flow for the 1965-66 fiscal year was 0.37 mgd. Treatment units include an Imhoff tank, sludge drying beds, a standard-rate trickling filter, a secondary clarifier, and an oxidation pond. The final effluent is discharged to a farm for irrigation of flowers.

Plans are to enlarge the existing facilities with no change in the point of effluent discharge.

Escondido Waste Water Treatment Plant

The new plant has a design capacity of 4.0 mgd and, for the 1965-66 fiscal year, treated 1.4 mgd. The plant consists of an influent pumping station, primary clarifier, aeration tanks, two secondary clarifiers, two chlorine contact tanks, and two digesters.

Fallbrook Waste Water Treatment Plant

The Fallbrook Waste Water Treatment Plant is a secondary treatment facility which serves an area of about 5 square miles. The plant, operated by the Fallbrook Sanitary District, has a design capacity of 0.35 mgd and for the 1965-66 fiscal year, had an average flow of 0.35 mgd. The plant consists of a comminutor, bar screen, a Parshall flume, a pumping station, an Imhoff tank, sludge drying beds, a high-rate trickling filter, and three aerated oxidation ponds operated in series. The plant effluent overflows into Fallbrook Creek; part of the effluent is used to irrigate fruit trees. Construction will be completed in 1967 for treatment capacity of 0.4 mgd.

The "North Coastal San Diego County Sewerage Survey" (20)* has recommended the use of the existing plant to treat waste water originating

*Reference 20 in Appendix A.

in the Santa Margarita drainage basin and the construction of a new plant for waste water originating in the San Luis Rey drainage basin.

Hide-Away-Lake Waste Water Treatment Plant

Hide-Away-Lake Mobile Estates is served by an activated sludge-type contact stabilization package plant. Effluent is spray-irrigated downstream from the plant.

Julian Waste Water Treatment Plant

Waste treatment facilities operated by the Julian Sanitation District consist of a septic tank with a design capacity of 0.05 mgd, followed by further treatment of the effluent in three oxidation ponds. The average flow of this system during the 1965-66 fiscal year was 0.01 mgd.

Lawrence Welk's Waste Water Treatment Plant

The Lawrence Welk's Country Club Village is currently providing secondary treatment by a contact stabilization activated sludge package plant at a rated capacity of 0.035 mgd. The average daily flow during the 1965-66 fiscal year was 0.011 mgd. Plans are now under way to replace the existing treatment plant with one that will handle flows of 0.05 mgd.

Leucadia Waste Water Treatment Plant

The Leucadia Waste Water Treatment Plant uses secondary treatment, consisting of a barminutor, primary clarifier, trickling filter, final clarifier, and chlorine contact chamber. The design capacity of the plant is 1.0 mgd and the average flow handled was 0.027 mgd for the 1965-66 fiscal year. The final effluent is discharged into percolation ponds above the

Los Batiquitos Lagoon in San Marcos Creek. The plant is operated by the Leucadia County Water District.

Oceanside Waste Water Treatment Plants

Oceanside is served by three waste water treatment plants, all of which discharge to Whelan Lake. The older plant, Las Salinas, located on Tait Street, is a secondary treatment facility with 5.0 mgd design capacity. The average flow through the plant for the 1965-66 fiscal year was 2.38 mgd. The plant consists of a preaeration lagoon, contact stabilization unit, settling tank, a gas chlorinator, and two heated digesters.

The San Luis Rey plant is also a secondary treatment facility, with a design capacity of 1.5 mgd. The average flow handled by the plant during the 1965-66 fiscal year was 0.26 mgd. The plant consists of an influent pumping station, a bar screen and comminutor, Parshall flume, two aeration and sedimentation tanks, a floating cover digester, and an effluent pumping station.

The Buena Vista plant is a secondary treatment facility with comminution, primary clarification, aeration, and secondary clarification and sludge digestion.

Pomerado Waste Water Treatment Plant

The Pomerado Sewage Treatment Plant was built in 1958 to serve Poway Valley and is operated by the Pomerado County Water District. The plant provides secondary treatment for a peak design capacity of 0.56 mgd, and during the 1965-66 fiscal year treated an average flow of 0.51 mgd. The plant consists of a bar screen, primary clarifier, three standard-rate trickling filters, secondary clarifier, and chlorine contact tank. The final effluent is discharged to Los Penasquitos Creek.

Future plans indicate expansion in stages to an ultimate design capacity of 1.12 mgd.

Rainbow Municipal Water District Waste Water Treatment Plants

The Gird Road Treatment Plant provides secondary treatment by an activated sludge-type contact stabilization package plant with a rated capacity of 0.015 mgd. Treatment facilities include bar rack, comminutor, aerated mixing chamber, sludge reaeration chamber, clarifier, chlorine contact chamber, aerobic sludge digestion and sludge drying beds. The average daily flow during the 1965-66 fiscal year was 0.01 mgd. Effluent is used for golf course irrigation.

The 76 Waste Water Treatment Plant provides secondary treatment by an activated sludge-type contact stabilization package plant with a rated capacity of 0.05 mgd. Treatment facilities include bar rack, comminutor, aerated mixing chamber, sludge reaeration chamber, clarifier, two percolation ponds, aerobic sludge digestion, and sludge drying beds.

The San Luis Rey Treatment Plant provides secondary treatment by a small, activated sludge-type package plant.

Ramona Waste Water Treatment Plant

The Ramona Waste Water Treatment Plant, operated by the Ramona Sanitation District, has a design capacity of 0.3 mgd and for the 1965-66 fiscal year treated an average flow of 0.10 mgd. The plant is a secondary treatment facility and includes an Imhoff tank, sludge digester, standard-rate trickling filter, secondary clarifier, oxidation pond, and holding pond for irrigation of sheep pasture.

Rancho Bernardo Waste Water Treatment Plant

The Rancho Bernardo Waste Water Treatment Plant was completed and its operation transferred to the City of San Diego in 1963. The plant is specifically designed for waste water reclamation. It has a design capacity of 0.5 mgd and consists of a comminutor, aeration unit, chlorine contact chamber, and two holding ponds. Average daily flow during the 1965-66 fiscal year was 0.19 mgd. The final effluent is reclaimed for irrigating the Rancho Bernardo golf course.

Plans indicate that three similar treatment plants, each with a design capacity of 2.0 mgd, will be constructed to handle the expected population of the community in 1970.

Rancho del Campo Waste Water Treatment Plant

The Rancho del Campo Waste Water Treatment Plant, operated by the County of San Diego, is a secondary treatment facility with a design capacity of 0.51 mgd. During the 1965-66 fiscal year, the plant treated and disposed of a 0.03 mgd average flow. Treatment equipment consists of a bar screen, two Imhoff tanks, two chlorine contact tanks, a trickling filter, two intermittent sand filters, and two final clarifiers. The final effluent is discharged to Campo Creek.

Rancho Santa Fe Waste Water Treatment Plant

The Rancho Santa Fe Waste Water Treatment Plant, operated by Rancho Santa Fe Sanitation District, consists of an extended aeration type of activated sludge treatment. The design capacity is 0.1 mgd with an average flow of 0.07 mgd during the 1965-66 fiscal year. The plant consists of a barminutor, aeration tank, secondary clarifier, and percolation ponds. The final effluent flows into the percolation ponds, where it infiltrates into the ground water basin.

San Elijo

The San Elijo Water Pollution Control Facility provides primary treatment and disposal facilities for Cardiff and Solana Beach Sanitation Districts. The plant began operation on May 10, 1966. The plant is designed to treat a maximum of 2 mgd. The average daily flow during June 1966 was 0.8 mgd. Facilities include comminutor, grit remover and washer, primary sedimentation tank, chlorination facilities, sludge digester and sludge centrifuge. Ocean disposal is through a 30-inch, 4,000-foot outfall. The plant is operated by the San Diego County Department of Special District Services.

San Marcos Waste Water Treatment Plant

San Marcos is served by a secondary waste water treatment plant with a design capacity of 0.10 mgd. The plant, which is operated by the San Marcos County Water District, consists of a comminutor and "rated aeration" package plant composed of an aeration chamber and final settling tank. The final effluent is discharged to San Marcos Creek. Construction plans are under way to provide San Marcos with waste disposal facilities at the Encina Water Pollution Control Facility.

Sorrento Waste Water Treatment Plant

The Sorrento Waste Water Treatment Plant is a secondary treatment facility operated by the City of San Diego to serve the Sorrento Industrial Park. The plant has a capacity of 0.6 mgd and during the

1965-66 fiscal year, treated an average flow of 0.43 mgd. Treatment units consist of a bar screen and comminutor, grit chamber, primary clarifier, chlorination facilities, sludge digester, and oxidation pond. The final effluent is discharged to Los Penasquitos Creek.

Plans include expansion of the treatment plant to an ultimate capacity of 1.2 mgd as soon as flow warrants the construction.

Utah Construction

The Utah Construction and Mining Company operates a secondary waste water treatment plant at Pauma Valley Country Club Estates. The plant has a rated capacity of 0.1 mgd. The average daily flow during 1965-66 was 0.01 mgd. Effluent is percolated to the ground water basin.

Valle Verde Waste Water Treatment Plant

The Valle Verde Waste Water Treatment Plant is a secondary treatment facility operated by the Valle Verde Community Services District. The plant has a design capacity of 0.3 mgd and consists of a bar screen, primary settling tanks, two aeration units, a chlorine contact chamber, and holding ponds. The final effluent will be used for irrigation of a golf course. The average daily flow during the 1965-66 fiscal year was 0.002 mgd.

Viejas Honor Camp Waste Water Treatment Plant

The Viejas Honor Camp Sewage Treatment Plant, operated by the Department of Honor Camps of the County of San Diego, consists of a "rated aeration" package-type plant. The plant provided secondary treatment for a design capacity of 0.02 mgd and a flow of 0.002 mgd during the 1965-66 fiscal year. The plant effluent is discharged to a tributary of the Sweetwater River.

Warner Springs

The Warner Springs Guest Ranch provides secondary treatment by an activated sludge-type contact stabilization package treatment. Effluent from the plant is used for golf course irrigation at the ranch.

Abandoned Facilities

Cardiff Waste Water Treatment Plant

The Cardiff Waste Water Treatment Plant served the community of Cardiff-by-the-Sea, plus a small portion of Encinitas. The plant, operated by the Cardiff Sanitation District, had a design capacity of 0.44 mgd. The average flow handled by the plant during the 1965-66 fiscal year was 0.48 mgd. The plant provided secondary treatment by means of a primary clarifier, sludge digester, aeration tanks, and oxidation pond. The final effluent was discharged into San Elijo Lagoon.

Cardiff and Solana Beach Sanitation Districts combined their resources to build the San Elijo Water Pollution Control Facility, which provides primary treatment of their wastes prior to ocean disposal. Flow was diverted to the San Elijo plant on May 10, 1966.

Carlsbad Waste Water Treatment Plant

The City of Carlsbad was served by a secondary treatment plant with a design capacity of 0.6 mgd. During the 1964-65 fiscal year, the plant treated an average flow of 0.6 mgd from a service area of 15 square miles. The plant consisted of an influent pumping station, chlorination facilities, Imhoff tank, two sludge drying beds, standard-rate trickling filter, two secondary clarifiers, and effluent holding pond. The final effluent flowed to Buena Vista Lagoon (Brown Bird Sanctuary).

The City of Carlsbad now disposes of its wastes through the Encina Water Pollution Control Facility, operated by San Diego County Department of Special District Services. Flow was diverted to the Encina plant on September 5, 1965.

Escondido Waste Water Treatment Plant

Escondido is now served by the new secondary waste water treatment plant. The old plant had a design capacity of 0.8 mgd and, during the 1964-65 fiscal year, treated an average flow of 0.94 mgd. It consisted of an influent pumping station, four primary clarifiers, a standard-rate trickling filter, three secondary clarifiers, a chlorine contact tank, and three sludge digesters.

Flow was diverted to the new plant in May 1966. The plant has been destroyed.

Solana Beach Waste Water Treatment Plant

The Solana Beach Waste Water Treatment Plant was a secondary treatment facility operated by the Solana Beach Sanitation District. The plant has a design capacity of 0.18 mgd and, for a portion of the 1965-66 fiscal year, treated an average daily flow of 0.25 mgd. The plant consists of a bar screen, Imhoff tank, standard-rate trickling filter, sludge digester, and two oxidation ponds in series. The final effluent was discharged to San Elijo Lagoon.

Service to Solana Beach Sanitation District is now provided by the San Elijo Water Pollution Control Facility, operated by San Diego County's Department of Special District Services. Flows were diverted to San Elijo on May 10, 1966.

Vista Waste Water Treatment Plant

The Vista Waste Water Treatment Plant consisted of two separate treatment units on one site, operated by the Vista Sanitation District. The average flow handled by this plant for the 1965-66 fiscal year was 1.14 mgd. The older unit has a design capacity of 0.9 mgd. It consists of an Imhoff tank, standard-rate trickling filter, and final clarifier. The newer unit consists of a barminutor, primary clarifier, sludge digester, high-rate trickling filter, and two oxidation ponds for additional treatment. The older and newer units together have a design capacity of 1.1 mgd. The final effluent was discharged into Buena Vista Creek.

The Vista Sanitation District has been served by the Encina Water Pollution Control Facility since September 5, 1965.

Camp Pendleton Subarea

The 12 existing sewage treatment plants in the Camp Pendleton Subarea are described below.

Camp Pendleton Waste Water Treatment Plant No. 1

Camp Pendleton Waste Water Treatment Plant No. 1 is a secondary treatment facility. The plant has a design capacity of 1.0 mgd and, for the 1965-66 fiscal year, treated an average flow of 0.50 mgd. Treatment units include a bar screen, a grit chamber, a primary clarifier, two trickling filters, a secondary clarifier, a two-stage digester, and chlorination facilities. The final effluent is discharged to a 12-million gallon holding pond, which is used for a fish hatchery, and the pond overflow discharges to Lake O'Neill.

Camp Pendleton Waste Water Treatment Plant No. 2

Camp Pendleton Waste Water Treatment Plant No. 2 is a secondary treatment facility. The plant has a design capacity of 0.5 mgd and, during the 1965-66 fiscal year, treated an average flow of 0.52 mgd. Treatment units include a bar screen, a grit chamber, primary and secondary clarifiers, two trickling filters, a single-stage sludge digester, and chlorination facilities. The final effluent is discharged to holding ponds from which part of the flow is used for golf course irrigation and the remainder is discharged to the Santa Margarita River drainage basin for recharge of ground water basins.

Camp Pendleton Waste Water Treatment Plant No. 3

Camp Pendleton Waste Water Treatment Plant No. 3 is a secondary treatment facility with a design capacity of 0.8 mgd. During the 1965-66 fiscal year, the plant treated and disposed of an average flow of 0.40 mgd. Treatment units consist of a bar rack, grit chamber, two primary clarifiers, two trickling filters, oxidation pond, a primary and a secondary digester, and chlorination facilities. The final effluent is discharged to the Santa Margarita River Basin for recharge of the ground water basin.

Camp Pendleton Waste Water Treatment Plants No. 4, 5, and 6

Operation of Camp Pendleton Waste Water Treatment Plants No. 4, 5, and 6 was discontinued in 1959.

Camp Pendleton Waste Water Treatment Plant No. 8

Camp Pendleton Waste Water Treatment Plant No. 8 is a secondary treatment facility. The plant has a design capacity of 0.32 mgd and, during the 1965-66 fiscal year, treated and discharged an average flow of 0.13 mgd. Treatment units include a bar screen, a grit chamber, primary clarifier, sludge digester, oxidation pond, and chlorination facilities. The final effluent is discharged into the Santa Margarita River for recharge of ground water basins.

Camp Pendleton Waste Water Treatment Plant No. 9

The Camp Pendleton Waste Water Treatment Plant No. 9 is a secondary treatment facility with a design capacity of 0.37 mgd. The plant consists of a bar screen, grit chamber, primary clarifier, sludge digester, oxidation ponds, and chlorination facilities. The plant effluent is discharged to a creek bed in Los Pulgas Canyon and recharges the ground water basin. Waste water flow for 1965-66 was 0.13 mgd.

Camp Pendleton Waste Water Treatment Plant No. 10.

Camp Pendleton Waste Water Treatment Plant No. 10 provides secondary treatment and has a design capacity of 0.37 mgd. Actual flow during 1965-66 was 0.12 mgd. Treatment units consist of a bar screen, grit chamber, primary clarifier, sludge digester, chlorination facilities, and oxidation ponds. The final effluent overflows into San Onofre Creek and recharges the ground water basin.

Camp Pendleton Waste Water Treatment Plant No. 11

Camp Pendleton Waste Water Treatment Plant No. 11 has a design capacity of 0.75 mgd. Waste water flow during 1965-66 was 0.37 mgd. The plant, which provides secondary treatment, consists of a bar screen, grit chamber, primary clarifiers, sludge digester, oxidation ponds, secondary clarifier, and chlorination facilities. The final effluent discharges to San Onofre Creek and recharges the ground water basin.

Camp Pendleton Waste Water Treatment Plant No. 12

Camp Pendleton Waste Water Treatment Plant No. 12 provides secondary treatment at a design capacity of 0.37 mgd. Waste water flow during 1965-66 was 0.32 mgd. The plant consists of a bar screen, grit chamber, primary clarifier, sludge digester, chlorination facilities, and oxidation ponds. The final effluent overflows to San Mateo Creek and recharges the ground water basin.

Camp Pendleton Waste Water Treatment Plant No. 13

Camp Pendleton Waste Water Treatment Plant No. 13 is a secondary treatment facility with a design capacity of 0.72 mgd. During the 1965-66 fiscal year, the plant treated and discharged an average flow of 0.57 mgd. Treatment units include a bar screen, grit chamber, primary clarifier, sludge digester, chlorination facilities, and oxidation ponds. The final effluent is discharged into the Santa Margarita River. Additions are now under construction for one secondary clarifier, one trickling filter, recirculating pumps and sludge heater.

Camp Pendleton Waste Water Treatment Plant No. 14

Camp Pendleton Waste Water Treatment Plant No. 14 is an 18-acre raw waste water stabilization pond with a treating capacity of 0.360 mgd. The plant commenced operation in October 1964.

Camp Pendleton Waste Water Treatment Plant No. 15

Camp Pendleton Waste Water Treatment Plant No. 15 is a 5.65-acre raw waste water stabilization pond, with a treating capacity of 0.110 mgd. The plant commenced operation in December 1966.

Naval Weapons Station, Fallbrook Annex Waste Water Treatment Plant

The Naval Weapons Station Waste Water Treatment Plant, serving that installation, provides primary treatment and chlorination at a design capacity of 0.33 mgd. During the 1965-66 fiscal year, the plant treated an average flow of 0.09 mgd. Treatment units include a comminutor, Imhoff tank, and chlorination facilities. The final effluent discharges into Fallbrook Creek.

APPENDIX D

QUANTITY AND QUALITY OF SEWAGE DISCHARGED IN COASTAL SAN DIEGO COUNTY

TABLE 20

TRUNK SEWER FLOWS,
SAN DIEGO METROPOLITAN SUBAREA

Trunk sewer	Flow given in million gallons per day / acre-feet per year		
	August 2-3, 1956	July 9-16, 1958	July 16-20, 1962
Balboa	0.90 / 1,010	1.60 / 1,790	2.60 / 2,920
Cabrillo	-- / --	0.52 / 580	0.30 / 360
East San Diego	7.60 / 8,470	6.40 / 7,170	12.60 * / 14,120
Encanto	-- / --	1.60 / 1,790	2.90 / 3,260
La Jolla	-- / --	3.10 / 3,470	4.30 / 4,850
Linda Vista	-- / --	0.86 / 960	-- / --
Mission Valley	2.30 / 2,600	2.70 / 3,020	3.20 / 3,550
Murray Canyon	-- / --	0.75 / 840	-- / --
National City	-- / --	1.45 / 1,620	-- / --
Rose Canyon	-- / --	0.30 / 340	2.20 * / 2,460

*May be in error due to backwater curves or other conditions at sampling point

TABLE 21

HISTORICAL QUANTITIES OF SEWAGE DISCHARGED IN THE
SAN DIEGO METROPOLITAN SUBAREA

Facility	Flow given in million gallons per day / acre-feet per year								
	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63	1963-64
Camp Elliot Sewage Treatment Plant	-- / --	-- / --	0.17 / 190	0.13 / 146	0.13 / 146	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	-- / --
Chula Vista "G" Street Plant	-- / --	-- / --	0.60 / 672	0.60 / 672	0.60 / 672	0.46 / 516	0.35 / 392	0.49 / 549	-- / --
"J" Street Plant	-- / --	1.71 / 1,920	1.66 / 1,860	1.90 / 2,130	2.15 / 2,414	2.35 / 2,635	2.80 / 3,133	2.69 / 3,008	-- / --
Coronado "B" Street Outfall	-- / --	1.26 / 1,412	-- / --	-- / --	-- / --	-- / --	0.39 / 437	0.39 / 437	-- / --
"K" Street Outfall	-- / --	-- / --	-- / --	-- / --	-- / --	-- / --	0.86 / 963	0.86 / 963	-- / --
El Cajon Sewage Treatment Plant	0.78 / 881	1.04 / 1,166	1.48 / 1,656	2.04 / 2,286	2.09 / 2,346	2.06 / 2,303	2.30 / 2,582	2.51 / 2,810	-- / --
Gillespie Field Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.02 / 23	0.03 / 34	0.04 / 45	0.03 / 34	-- / --
Imperial Beach Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.80 / 900	0.85 / 950	-- / --	-- / --	-- / --
International Sewer Outfall	3.48 / 3,912	3.72 / 4,171	4.45 / 4,985	4.45 / 4,980	4.38 / 4,922	3.80 / 4,206	1.92 / 2,151	0.00 / 0.00	0.00 / 0.00
Lakeside Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.04 / 46	0.04 / 46	0.15 / 168	0.18 / 202	0.23 / 259
Palm City Sewage Treatment Plant	-- / --	-- / --	-- / --	0.46 / 516	0.61 / 682	0.75 / 840	0.79 / 885	0.87 / 975	-- / --
Ream Field Sewage Treatment Plant	-- / --	-- / --	0.20 / 224	0.22 / 242	0.09 / 101	0.08 / 90	0.12 / 134	0.12 / 134	-- / --
San Diego Harbor Drive Plant	39.90 / 44,786	42.50 / 47,648	44.60 / 49,914	45.80 / 51,357	47.90 / 53,683	47.80 / 53,582	48.80 / 54,650	48.00 / 53,767	-- / --
Santee Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.45 / 509	0.56 / 628	0.85 / 952	0.80 / 896	0.85 / 948
San Ysidro Sewage Treatment Plant	-- / --	-- / --	-- / --	-- / --	0.20 / 224	0.20 / 224	0.30 / 336	0.30 / 336	0.26 / 288
Spring Valley Sewage Treatment	-- / --	-- / --	-- / --	0.79 / 885	1.26 / 1,414	1.23 / 1,378	1.56 / 1,748	1.71 / 1,915	-- / --

TABLE 22

HISTORICAL QUANTITIES OF SEWAGE DISCHARGED IN THE
SAN DIEGO COUNTY SUBAREA

Facility	Flow given in million gallons per day / acre-feet per year								
	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63	1963-64
Alpine Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.01 11	0.01 11	0.01 11	0.01 11	0.02 22
Callan Sewage Treatment Plant	-- --	-- --	-- --	0.04 45	-- --	-- --	0.24 268	0.30 336	0.33 374
Cardiff Sewage Treatment Plant	-- --	-- --	-- --	-- --	-- --	0.21 235	0.28 312	0.30 336	0.37 418
Carlsbad Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.60 672	0.60 672	0.47 526	0.47 526	0.45 505
Del Mar Sewage Treatment Plant	-- --	-- --	-- --	-- --	-- --	0.18 202	0.18 202	0.20 224	0.24 266
Encinitas Sewage Treatment Plant	-- --	-- --	-- --	-- --	-- --	-- --	0.30 336	0.30 336	-- --
Escondido Old plant	0.63 706	0.68 760	1.04 1,165	-- --	1.13 1,271	0.58 649	0.71 798	0.69 773	-- --
New plant	-- --	-- --	-- --	-- --	-- --	0.55 620	0.68 761	0.78 874	1.64 1,843
Fallbrook Sewage Treatment Plant	-- --	-- --	0.16 179	0.17 190	0.27 302	-- --	-- --	0.25 280	0.30 336
Julian Sewage Treatment Plant	-- --	-- --	-- --	-- --	-- --	0.01 11	0.01 11	0.01 11	0.01 11
Oceanside Sewage Treatment Plant*	1.60 1,798	1.58 1,775	1.83 2,053	1.83 2,053	2.12 2,373	2.17 2,555	2.41 2,704	2.59 2,901	2.64 3,026
Pomerado Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.12 134	0.21 235	0.39 437	0.31 437	0.41 460
Ramona Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.07 79	0.07 79	0.06 67	0.10 110	0.10 110
Rancho del Campo Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.04 45	0.04 45	0.04 45	0.04 45	-- --
Rancho Santa Fe Sewage Treatment Plant	-- --	-- --	-- --	-- --	-- --	0.02 22	0.04 45	0.05 56	0.05 56
San Marcos Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.04 45	0.07 79	0.07 79	0.17 190	0.16 178
Solana Beach Sewage Treatment Plant	-- --	-- --	-- --	-- --	0.17 192	0.15 168	0.15 168	0.20 224	0.24 269
Vista Sewage Treatment Plant	-- --	-- --	-- --	0.86 963	1.02 1,145	0.99 1,110	1.16 1,298	1.11 1,240	1.12 1,252

*The flows from Oceanside's three plants are combined here because all discharge to the same point (Whelan Lake).

TABLE 23

HISTORICAL QUANTITIES OF SEWAGE DISCHARGED IN THE
CAMP PENDLETON SUBAREA

Facility	Flow given in million gallons per day / acre-feet per year								
	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63	1963-64
Camp Pendleton Plant No. 1	1.03 / 1,161	0.71 / 795	0.79 / 885	0.66 / 740	0.63 / 706	0.67 / 751	0.67 / 751	0.62 / 694	0.57 / 639
Plant No. 2	0.66 / 740	0.73 / 818	0.66 / 740	0.66 / 740	0.61 / 685	0.62 / 694	0.66 / 740	0.63 / 706	0.65 / 723
Plant No. 3	0.63 / 706	0.55 / 616	0.52 / 582	0.42 / 471	0.37 / 415	0.30 / 336	0.31 / 347	0.37 / 415	0.32 / 353
Plant No. 4*	0.07 / 75	0.08 / 90	0.07 / 75	0.08 / 90	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	-- / --
Plant No. 5*	0.22 / 246	0.20 / 224	0.21 / 235	0.22 / 246	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	-- / --
Plant No. 6*	0.07 / 75	0.06 / 67	0.06 / 67	0.06 / 67	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	-- / --
Plant No. 8	0.24 / 269	0.23 / 258	0.23 / 258	0.22 / 246	-- / --	-- / --	-- / --	-- / --	0.25 / 275
Plant No. 9	0.27 / 302	0.36 / 403	0.32 / 358	0.28 / 314	-- / --	-- / --	-- / --	-- / --	0.25 / 275
Plant No. 10	0.12 / 134	0.12 / 134	0.12 / 134	0.15 / 168	-- / --	-- / --	-- / --	-- / --	0.14 / 156
Plant No. 11	0.31 / 347	0.37 / 414	0.19 / 213	0.16 / 179	-- / --	-- / --	-- / --	-- / --	0.27 / 304
Plant No. 12	0.30 / 336	0.33 / 370	0.25 / 280	0.22 / 246	-- / --	-- / --	-- / --	-- / --	0.38 / 426
Plant No. 13	0.23 / 258	0.22 / 246	0.18 / 202	0.33 / 370	0.45 / 504	0.38 / 426	0.44 / 483	0.41 / 459	0.37 / 414
Fallbrook Naval Reservation Sewage Treatment Plant	-- / --	-- / --	0.26 / 290	-- / --	-- / --	-- / --	0.03 / 34	0.03 / 34	0.04 / 45

*This plant was discontinued in 1959.

TABLE 24

MINERAL QUALITY OF EFFLUENTS FROM SEWAGE PLANTS IN THE SAN DIEGO METROPOLITAN SUBAREA

Property*	Chula Vista "G" Street plant	Chula Vista "J" Street plant	Coronado "B" Street outfall	Coronado "K" Street outfall	El Cajon plant	Gillespie Field plant	Imperial Beach plant
Treatment	Primary	Primary	None	None	Aeration	Trickling filter	Trickling filter & lagoon
Date sampled	6-20-60 6-21-60	5-9-62	6-20-60	6-20-60	5-9-62	7-19-62	7-18-62
pH	7.4	7.3	8.6	7.3	7.2	7.7	7.8
EC x 10^6 at 25° C.	1,791	2,155	1,209	2,150	2,374	1,600	15,250
Calcium	75	77	66	70	82	73	230
Magnesium	39	37	27	47	54	30	388
Sodium	189	271	93	276	304	195	3,100
Potassium	14	17	5	14	19	20	330
Ammonium	25	93	23	0.0	77	4	2
Carbonate	0.0	0.0	3.0	0.0	0.0	0.0	0.0
Bicarbonate	295	783	86	75	433	128	310
Sulfate	309	108	323	326	308	174	931
Chloride	197	283	94	395	381	238	5,754
Nitrate	0.0	0.0	2.0	26	0.0	67	0.0
Fluoride	3	0.75	0.4	0.2	1.8	6.2	0.4
Boron	1	1	0	0.2	1	3.5	2
Silica	36	--	9	32	16	13	31
Total dissolved solids	1,200	1,610	785	1,365	1,690	1,004	11,028
Total hardness as $CaCO_3$	349	345	275	371	355	309	2,168
Noncarbonate hardness as $CaCO_3$	107	0.00	200	309	71	204	1,914
Organic Nitrogen as N	18	--	20	1.0	--	12	9
Nitrite as N	0.0	--	0.1	0.1	--	0.3	0.0
Orthophosphate	37	90	3	1	56	0.0	8
ABS detergents	--	--	--	--	--	0.9	7
Percent sodium	48	49	37	61	50	55	72

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivity in micromhos per cm. at 25° C.

TABLE 24

MINERAL QUALITY OF EFFLUENTS FROM SEWAGE PLANTS IN THE SAN DIEGO METROPOLITAN SUBAREA
(continued)

Property*	Lakeside plant	Palm City plant	Ream Field plant	San Diego Harbor Drive plant	San Diego Point Loma plant	Santee plant	San Ysidro plant	Spring Valley plant
Treatment	Lagoon	Trickling filter & lagoon	Primary	Primary	Primary	Aeration & lagoon	Lagoon	Trickling filter
Date Sampled	7-19-62	7-18-62	7-18-62	6-14-62	9-26-63	5-17-62	10-9-62	6-13-62
pH	7.8	8.0	7.3	7.1	6.8	8.4	7.8	7.2
EC x 10^6 at 25° C.	2,160	7,000	1,910	2,792	2,650	1,621	1,890	2,697
Calcium	88	220	94	84	134	64	70	106
Magnesium	41	140	34	50	24	35	44	59
Sodium	305	1,200	205	396	375	202	275	386
Potassium	33	101	28	23	23	20	19	15
Ammonium	18	21	16	65	25	31	--	--
Carbonate	0.0	0.0	0.0	0.0	0.0	36	0.0	0.0
Bicarbonate	318	561	301	458	331	199	217	367
Sulfate	452	396	200	289	331	298	405	420
Chloride	327	2,184	325	534	514	220	280	459
Nitrate	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
Fluoride	0.8	0.6	0.4	1.0	0.8	0.2	0.8	1.9
Boron	0.9	1.2	0.6	1.3	0.8	0.9	0.7	1.3
Silica	33	40	23	20	24	30	29	23
Total dissolved solids	1,436	4,232	1,252	1,950	1,670	1,125	1,266	1,850
Total hardness as $CaCO_3$	391	1,125	378	375	435	223	355	505
Noncarbonate hardness as $CaCO_3$	130	665	131	40	163	84	177	204
Organic Nitrogen as N	81	--	--	--	16	1	--	--
Nitrite as N	0.0	0.0	0.0	--	0.0	0.2	--	--
Orthophosphate	11	21	8	48	29	6	9	--
ABS detergents	10	8	3	--	8	9	19	--
Percent sodium	58	67	49	58	64	51	61	62

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivity in micromhos per cm. at 25° C.

TABLE 25

MINERAL QUALITY OF SEWAGE FROM TRUNK SEWERS
IN THE SAN DIEGO METROPOLITAN SUBAREA

Property*	Balboa	Cabrillo	East San Diego	Encanto	La Jolla	Linda Vista	Mission Valley	Murray Canyon	National City	Rose Canyon
Date sampled	7-17-62 7-18-62	7-17-62 7-18-62	7-18-62 7-19-62	7-18-62 7-19-62	7-19-62 7-20-62	1-31-61	7-16-62 7-17-62	7- 9-58 7-16-58	7-15-58 7-16-58	7-19-62 7-20-62
pH	7.5	7.5	7.3	7.5	7.3	7.4	7.9	6.8	7.4	7.5
EC x 10^6 at 25° C.	1,525	1,530	1,760	2,400	2,500	1,626	1,810	1,563	1,571	1,910
Calcium	73	72	89	96	82	57	46	65	44	109
Magnesium	48	37	41	45	55	35	41	26	24	39
Sodium	172	174	195	346	325	200	250	175	198	210
Potassium	25	24	27	30	45	18	26	22	18	31
Ammonium	5.8	4.5	21	16	37	49	19	49	62	40
Carbonate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	266	260	328	378	314	390	319	328	395	396
Sulfate	362	348	373	375	384	337	336	270	136	379
Chloride	144	145	202	420	459	160	232	150	194	229
Nitrate	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0
Fluoride	1.8	0.7	0.5	0.3	0.8	0.4	1	0.2	0.6	0.1
Boron	0.8	0.8	0.8	0.8	0.6	1.2	0.9	0.6	0.6	1
Silica	30	32	30	29	25	20	33	32	32	22
Total dissolved solids	1,026	1,064	1,300	1,696	1,892	1,060	1,180	1,172	1,056	1,124
Total hardness as $CaCO_3$	382	334	395	423	430	284	283	270	211	433
Noncarbonate hardness as $CaCO_3$	164	120	126	103	172	0.0	21	2	0.0	108
Organic Nitrogen as N	4	3	26	6	3	--	--	--	--	--
Nitrite as N	0.0	0.0	0.0	0.0	0.0	--	0.0	--	--	0.0
Orthophosphate	18	20	12	13	9	--	24	22	46	7
ABS detergents	7	8	11	11	7	--	8	--	--	5
Percent sodium	46	50	46	60	58	49	60	47	52	44

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivity in micromhos per cm. at 25° C.

TABLE 26

MINERAL QUALITY OF EFFLUENTS FROM SEWAGE PLANTS IN THE SAN DIEGO COUNTY SUBAREA

Property*	Alpine	Callan	Cardiff	Carlsbad	Del Mar	Encinitas	Escondido (older plant)	Escondido (newer plant)	Fallbrook	Julian
Treatment	Lagoons	Lagoons	Lagoon	Trickling filter	Lagoons	Trickling filter & lagoon	Trickling filter	Aeration	Lagoons	Lagoons
Date sampled	7-17-62	10-9-62	5-10-62	5-10-62	5-10-62	6-20-62	7-3-63	7-2-63	5-6-63	7-17-62
pH	9.6	7.1	7.6	7.4	8.5	7.3	7.1	7.2	7.8	7.7
EC x 10^6 at 25° C.	1,110	1,460	1,784	2,965	1,819	2,166	1,925	1,950	1,650	485
Calcium	34	98	58	114	68	56	97	71	83	38
Magnesium	27	37	50	83	45	44	41	46	34	9
Sodium	180	160	285	492	331	336	250	275	235	50
Potassium	30	11	21	19	46	23	20	24	14	11
Ammonium	0.0	--	44	3	8	42	--	--	--	3
Carbonate	97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	103	145	377	261	267	370	191	284	311	155
Sulfate	132	362	342	279	380	347	320	323	344	48
Chloride	171	196	272	789	340	288	326	284	182	50
Nitrate	0.0	0.0	0.0	10	1	16	22	4	0.0	0.0
Fluoride	1	0.2	1.1	1.7	0.7	2.5	1.2	1.6	0.8	0.8
Boron	0.8	0.3	0.9	0.5	0.9	1.3	0.7	0.9	0.7	0.3
Silica	43	9	22	16	31	14	27	28	23	25
Total dissolved solids	814	1,008	1,365	2,080	1,390	1,550	1,450	1,292	1,020	328
Total hardness as $CaCO_3$	194	397	348	626	353	303	412	365	347	133
Noncarbonate hardness as $CaCO_3$	0.0	278	39	412	134	19	255	132	92	5
Organic Nitrogen as N	0.5	--	0.4	4	5	2	--	--	--	2
Nitrite as N	0.1	--	0.8	1	0.7	2	--	--	--	0.1
Orthophosphate	0.0	2	35	34	17	56	--	--	--	16
ABS detergents	7	0.5	--	--	--	9	--	--	5	4
Percent sodium	63	46	56	62	62	61	55	60	58	28

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivity in micromhos per cm. at 25° C.

TABLE 26

MINERAL QUALITY OF EFFLUENTS FROM SEWAGE PLANTS IN THE SAN DIEGO COUNTY SUBAREA (continued)

Property*	Oceanside	Pomerado	Ramona	Rancho del Campo	Rancho Santa Fe	San Marcos	Solana Beach	Sorrento	Viejas Honor Camp	Vista
Treatment	Lagoon	Trickling filter	Trickling filter & lagoon	Trickling filter	Aeration	Aeration	Trickling filter & lagoons	Lagoon	Aeration	Trickling filter & lagoons
Date sampled	7-2-63	7-16-62	7-16-62	7-17-62	7-16-62	5-2-62	5-10-62	10-9-62	7-17-62	5-2-62
pH	7.4	8.1	8.9	8.1	8.2	7.0	7.6	7.5	7.7	7.2
EC x 10^6 at 25° C.	2,600	2,040	1,810	1,120	2,000	1,799	2,906	10,200	1,130	1,847
Calcium	106	61	54	42	63	76	58	371	33	96
Magnesium	63	53	45	32	34	55	57	376	34	50
Sodium	370	265	270	137	315	244	492	1,725	150	216
Potassium	23	26	25	16	26	16	23	25	21	13
Ammonium	--	28	4	0.0	2	13	40	--	5	34
Carbonate	0.0	0.0	41	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	460	346	274	289	254	303	342	220	392	426
Sulfate	322	341	218	81	330	308	349	2,323	55	213
Chloride	470	308	298	127	332	256	725	2,613	138	286
Nitrate	0.0	4	8	58	2	1	0.0	0.0	0.0	0.0
Fluoride	1	0.5	1	0.5	1	1.6	0.8	0.8	0.8	1.1
Boron	0.8	0.8	0.8	0.5	0.4	0.1	0.6	1.1	0.2	0.1
Silica	24	30	32	47	10	24	20	11	62	26
Total dissolved solids	1,728	1,254	1,198	758	1,468	1,265	2,070	7,970	746	1,320
Total hardness as $CaCO_3$	523	390	322	237	298	415	532	2,468	222	444
Noncarbonate hardness as $CaCO_3$	147	106	30	0.0	90	167	252	2,288	0.0	95
Organic Nitrogen as N	--	--	--	1	2	0.0	0.0	--	0.3	20
Nitrite as N	--	0.2	0.5	0.4	0.1	0.3	0.5	--	0.0	0.0
Orthophosphate	--	36	9	23	16	58	24	0.0	16	11
ABS detergents	--	6	4	5	0.8	--	--	--	5	--
Percent sodium	59	52	62	54	66	53	61	60	51	46

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivity in micromhos per cm. at 25° C.

TABLE 27

MINERAL QUALITY OF EFFLUENTS FROM SEWAGE PLANTS IN THE CAMP PENDLETON SUBAREA

Property*	Camp Pendleton No. 1	Camp Pendleton No. 2	Camp Pendleton No. 3	Camp Pendleton No. 8**	Camp Pendleton No. 9**	Camp Pendleton No. 10**	Camp Pendleton No. 11**	Camp Pendleton No. 12**	Camp Pendleton No. 13	Fallbrook Naval Reservation
Treatment	Trickling filters & lagoon	Trickling filters & lagoons	Trickling filters & lagoon	Lagoons	Lagoons	Lagoons	Lagoons	Lagoons	Lagoons	Primary
Date sampled	7-5-62	7-5-62	7-5-62	2-25-60	8-59	8-59	8-59	8-59	7-5-62	7-14-60
pH	7.2	7.6	8.2	7.6	8.4	7.4	7.6	10.0	8.1	7.4
EC x 10^6 at 25° C.	1,401	1,240	1,560	1,340	1,865	1,260	1,450	880	1,250	1,530
Calcium	48	65	33	51	65	73	63	38	46	--
Magnesium	35	24	23	24	45	26	32	12	35	--
Sodium	179	158	275	221	200	128	169	120	234	--
Potassium	11	14	26	--	--	--	--	--	21	--
Ammonium	6	3	3	--	--	--	--	--	35	--
Carbonate	0.0	0.0	0.0	--	24	0.0	0.0	43	0.0	--
Bicarbonate	231	232	282	232	376	264	202	15	422	--
Sulfate	134	111	124	120	66	98	90	92	146	--
Chloride	211	196	308	218	322	180	246	160	275	--
Nitrate	41	10	3	3	--	--	--	--	0.0	--
Fluoride	1.7	0.8	0.4	0.4	--	--	--	--	2	0.4
Boron	0.6	0.3	0.6	0.5	0.5	0.6	0.4	0.3	0.6	--
Silica	25	23	43	24	35	32	42	21	32	--
Total dissolved solids	950	746	982	940	1,305	880	1,015	615	1,092	1,070
Total hardness as $CaCO_3$	189	262	175	228	350	290	288	144	260	--
Noncarbonate hardness as $CaCO_3$	74	72	0.0	128	164	182	158	96	0.0	--
Organic Nitrogen as N	0.5	3	8	--	--	--	--	--	43	--
Nitrite as N	0.4	0.3	0.2	--	--	--	--	--	0.5	--
Orthophosphate	33	10	8	--	12	12	15	0.4	24	--
ABS detergents	5	5	6	--	--	--	--	--	7	--
Percent sodium	57	54	73	76	60	488	56	64	55	--

*All chemical constituents are in parts per million, except pH, EC, and percent sodium. EC is electrical conductivity in micromhos per cm. at 25° C.
**Samples taken and analyzed by the Eleventh Naval District.

APPENDIX E

WATER QUALITY CRITERIA

APPENDIX E

WATER QUALITY CRITERIA

For quality standards, water supplies are classified in three general types: domestic, agricultural, and industrial.

Municipal and Domestic Water Quality Criteria

Water used for drinking and cooking should be clear, colorless, odorless, pleasant to the taste, and free from toxic salts. It should not contain excessive amounts of dissolved mineral solids, and it must be free of pathogenic organisms. Probably the most widely used criteria in determining the suitability of a water for this use are the "Public Health Service Drinking Water Standards, 1962", given in Table 28.

Maximum safe limits of fluoride ion concentrations are related to mean annual temperature and are defined by the California State Department of Public Health as follows:

Mean annual temperature, in °F	Mean monthly maximum fluoride ion concentration, in ppm
50	1.5
60	1.0
70 - above	0.7

Total hardness is a significant factor in the determination of the suitability of water for domestic or municipal use. Waters containing 100 parts per million (ppm) or less of hardness (as $CaCO_3$) are considered "soft", those containing 101 to 200 ppm are considered "moderately hard", and those with more than 200 ppm are considered "very hard".

TABLE 28

UNITED STATES PUBLIC HEALTH SERVICE
DRINKING WATER STANDARDS

1962

Substance	Recommended limits of concentrations, in mg/l	Mandatory limits of concentrations, in mg/l
Alkyl benzene sulfonate (ABS)	0.5	
Arsenic (As)	0.01	0.05
Barium (Ba)	--	1.0
Cadmium (Cd)	--	0.01
Carbon chloroform extract (CCE)	0.2	--
Chloride (Cl)	250	--
Chromium (Hexavalent) (Cr^{+6})	--	0.05
Copper (Cu)	1.0	--
Cyanide (CN)	0.01	0.2
Fluoride (F)		
Iron (Fe)	0.3	--
Lead (Pb)	--	0.05
Manganese (Mn)	0.05	--
Nitrate (NO_3)*	45	--
Phenols	0.001	--
Selenium (Se)	--	0.01
Silver (Ag)	--	0.05
Sulfate (SO_4)	250	--
Total dissolved solids (TDS)	500	--
Zinc (Zn)	5	--

*In areas in which the nitrate content of water is known to be in excess of the listed concentration, the public should be warned of the potential dangers of using the water for infant feeding.

Irrigated Agriculture Water Quality Criteria

The major criteria for judging the suitability of water for irrigation are chloride concentration, specific electrical conductance (presented as EC x 10^6 at 25° C), boron concentration, and percent sodium.

Chlorides are present in nearly all waters. They are not necessary to plant growth and, in high concentrations, cause subnormal growing rates and burning of leaves. Relative tolerances of various crop plants to salt are indicated in Table 29.

TABLE 29

RELATIVE TOLERANCE OF CROP PLANTS TO SALT[27]

High salt tolerance	Medium salt tolerance	Low salt tolerance
Date palm	Pomegranate	Pear
Salt grass	Fig	Apple
Bermuda grass	Olive	Orange
Rescue grass	Sweet corn	Grapefruit
Western wheatgrass	Potatoes (White Rose)	Prune
Barley	Carrot	Plum
Sugar beet	Onion	Almond
Rape	Sudan grass	Apricot
Cotton	Alfalfa (California common)	Peach
	Rye	Strawberry
	Wheat	Lemon
	Oats	Avocado
	Orchardgrass	Field beans
	Rice	Radish
	Meadow fescue	Celery
	Sorghum (grain)	Meadow foxtail
	Corn (field)	Red clover
	Flax	
	Sunflower	
	Castor beans	

Electrical conductance indicates the total dissolved solids and furnishes an approximate indication of the overall mineral quality of the water. For most waters, the total dissolved solids, measured in parts per million, may be approximated by multiplying the specific electrical conductance by 0.7. As the amount of dissolved salts in irrigation water increases, the crop yields are reduced until, at high concentrations (the value depending on the plant, type of soil, climatological conditions, and amount of water applied), plants cannot survive.

Boron is never found in the free state but occurs in the form of borates or boric acid. This element is essential in minor amounts for the growth of many but not all plants. It is, however, extremely toxic to most plants in higher concentrations. Limits of tolerance for most irrigated crops vary from 0.5 to 2.0 ppm. Citrus crops, particularly lemons, are sensitive to boron in concentrations exceeding 0.5 ppm. Relative tolerances of various crop plants to boron are listed in Table 30 and permissible limits of boron for several classes of irrigation water are shown in Table 31.

TABLE 30

RELATIVE TOLERANCE OF CROP PLANTS TO BORON[26]

(In each group the plants first named are considered as being more sensitive and the last named more tolerant)

Sensitive to boron	Semitolerant to boron	Tolerant to boron
Lemon	Lima bean	Carrot
Grapefruit	Sweet potato	Lettuce
Avocado	Bell pepper	Cabbage
Orange	Tomato	Turnip
Thornless blackberry	Pumpkin	Onion
Apricot	Zinnia	Broad bean
Peach	Oat	Gladiolus
Cherry	Milo	Alfalfa
Persimmon	Corn	Garden beet
Kadota fig	Wheat	Mangel
Grape (Sultanina and Malaga)	Barley	Sugar beet
Apple	Olive	Palm (Phoenix carariensis)
Pear	Ragged robin rose	Date palm (P. dactylifera)
Plum	Field pea	Asparagus
American elm	Radish	Athel (Tamarix aphylla)
Navy bean	Sweet pea	
Jerusalem-artichoke	Pima cotton	
Persian (English) walnut	Acala cotton	
Black walnut	Potato	
Pecan	Sunflower (native)	

The percent sodium, as reported in analyses, is 100 times the proportion of the sodium cation to the sum of all cations, all expressed in equivalents per million. Water containing a high percent sodium has

TABLE 31

PERMISSIBLE LIMITS OF BORON FOR SEVERAL CLASSES OF[26] IRRIGATION WATER

In parts per million

Classes of water	Crop groups		
	Sensitive	Semitolerant	Tolerant
Excellent	Less than 0.33	Less than 0.67	Less than 1.00
Good	0.33 to 0.67	0.67 to 1.33	1.00 to 2.00
Permissible	0.67 to 1.00	1.33 to 2.00	2.00 to 3.00
Doubtful	1.00 to 1.25	2.00 to 2.50	3.00 to 3.75
Unsuitable	Greater than 1.25	Greater than 2.50	Greater than 3.75

an adverse effect on the physical structure of soils that contain clay. This is because it disperses the soil colloids, and these, in turn, retard the movement of water and the leaching of salts, and make the soils difficult to work. The effect of potassium in water is similar to that of sodium.

Because of the diverse climatological conditions, crops, soils, and irrigation practices in California, criteria that may be set up to establish the suitability of water for irrigation must be general, and judgment must be used in applying these criteria to individual cases.

Based on results of studies by Dr. L. D. Doneen, Professor of Irrigation at the University of California at Davis, three general classes of irrigation water have been established:

Class 1 Excellent to good. Regarded as safe and suitable for most plants under any condition of soil or climate.

Class 2 Good to injurious. Regarded as possibly harmful for certain crops under certain conditions of soil or climate, particularly in the higher ranges of this class.

Class 3 Injurious to unsatisfactory. Regarded as probably harmful to most crops and unsatisfactory for all but the most tolerant.

Limiting values for concentrations of total dissolved solids, chloride, boron, electrical conductance, and percent sodium for these three classes of irrigation water are shown in Table 32.

TABLE 32

UNIVERSITY OF CALIFORNIA CRITERIA FOR IRRIGATION WATERS

Factors	Class 1 Excellent to good	Class 2 Good to injurious	Class 3 Injurious to unsatisfactory
Electrical conductance, EC x 10^6 at 25° C	Less than 1,000	1,000 - 3,000	More than 3,000
Boron, ppm	Less than 0.5	0.5 - 2.0	More than 2.0
Chloride, ppm	Less than 175	175 - 350	More than 350
Percent sodium	Less than 60	60 - 75	More than 75

Industrial Water Quality Criteria

A standard of quality of water for industrial purposes is exceedingly difficult to ascertain. Industrial usage of water is so varied that a single set of standards for chemical, physical, and bacterial requirements would be meaningless. Table 33 shows approximate water quality requirements for individual industries; the quality limits should be considered flexible. Even criteria obtained for the industries mentioned are not conclusive for all constituents. Water for industrial purposes must, therefore, be considered as a raw material to be treated, if necessary, by the industrial user to fit individual needs and requirements.

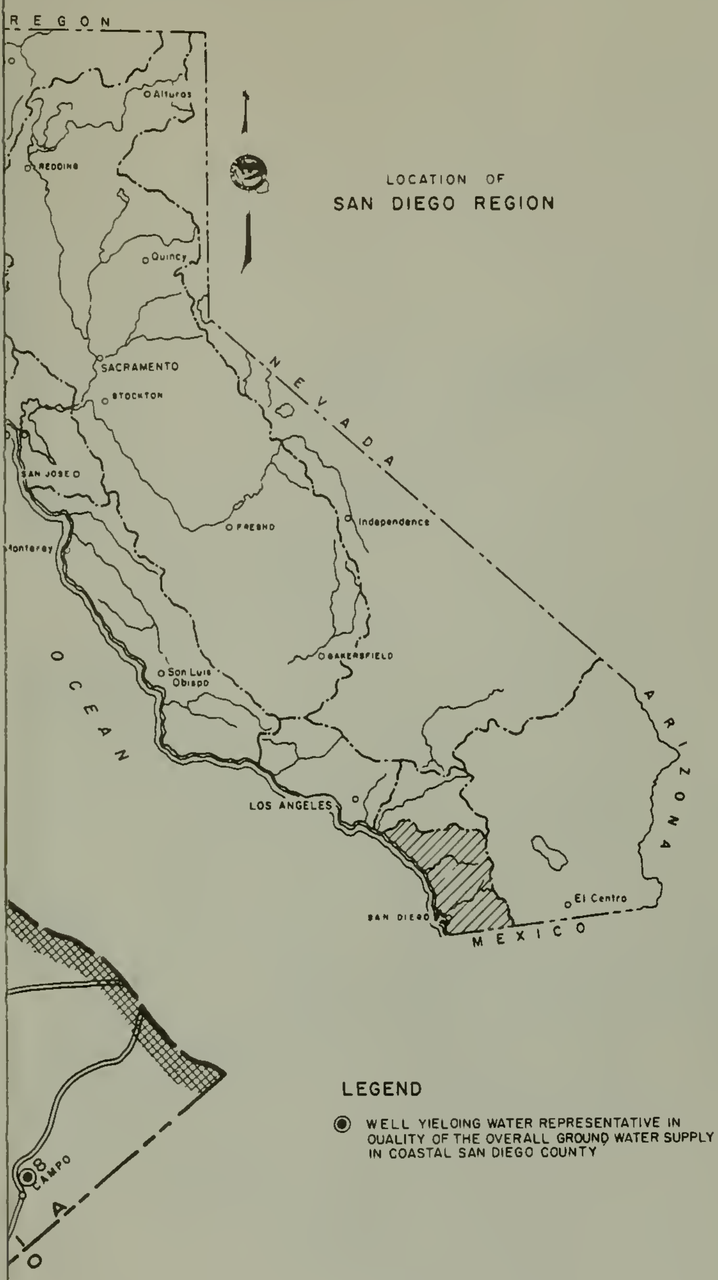
TABLE 33

LIMITS OF MINERAL CONCENTRATIONS, PHYSICAL PROPERTIES, AND SANITARY QUALITY OF WATER FOR VARIOUS INDUSTRIAL USES

Allowable limits in parts per million except as noted

Constituent or property	Boiler feed water[a] boiler pressure in pounds per square inch				Concrete mixing[a,e]	Cooling water[a,f]	Steel manufacturing[a]	Tanning operations[a]	Textile manufacturing[a]	Production of papers[a]	
	0-150	150-250	250-400	over 400						Groundwood[g]	Soda and sulfate pulp[h]
Total Solids	3,000-500[b]	2,500-500[b]	1,500-100[b]	50[b]	-- --	-- --	-- --	-- --	-- --	-- --	-- --
pH value	8.0 minimum	8.4 minimum	9.0 minimum	9.6 minimum	high values desired	7 to 9[f]	6.8 to 7.0	6.0 to 8.0	--	--	--
Chlorides (Cl)	--	--	--	--	--	--	175	--	100	75	75
Iron (Fe)	--	--	--	--	--	0.5[a]	--	0.1 to 2.0	0.1 to 1.0	0.3	0.1
Manganese (Mn)	--	--	--	--	--	0.5[a]	--	0.1 to 0.2	0.05 to 1.0	0.1	0.05
Iron and Manganese (Fe + Mn)	--	--	--	--	--	0.5[a]	--	0.2	0.2 to 1.0	--	--
Suspended matter	--	--	--	--	--	--	25	--	--	--	--
Temperature, °F.	--	--	--	--	--	--	75	--	--	--	--
Turbidity	20	10	5	1	--	50[a]	--	20	0.3 to 25	--	--
Color	80	40	5	2	--	--	--	10 to 100	0 to 70	30[j]	5[j]
Dissolved oxygen	1.4[c]	0.14	0.0[c]	0.0[c]	--	--	--	--	--	--	--
Hydrogen sulfide (H_2S)	5[d]	3[d]	0[d]	0[d]	--	--	--	--	--	--	--
Total hardness (as $CaCO_3$)	80	40	10	2	100 minimum	50[a]	50	50 to 513	0 to 50	200	100
Sulfate-carbonate ratio (ASME) ($Na_2SO_4 : Na_2CO_3$)	1:1	2:1	3:1	3:1	--	--	--	--	--	--	--
Aluminum oxide (Al_2O_3)	5	0.5	0.05	0.01	--	--	--	--	--	--	--
Silica (SiO_2)	40	20	5	1	--	--	--	--	--	--	--
Bicarbonate (HCO_3)	50[c]	30[c]	5[c]	0[c]	--	--	--	--	--	--	--
Carbonate (CO_3)	200	100	40	20	--	--	--	--	--	--	--
Hydroxide (OH)	50	40	30	15	--	--	--	--	--	--	--
Oxygen consumed	15	10	4	3	--	--	--	--	8	--	--
Total dissolved solids	--	--	--	--	--	2,500[f]	--	--	--	500	250
Free carbon dioxide (CO_2)	--	--	--	--	20	--	--	--	--	10	10
Sulfide (SO_3)	--	--	--	--	25	--	--	--	--	--	--
5 day BOD	--	--	--	--	--	--	25	--	--	--	--
Corrosion potential	--	--	--	--	--	--	Low as possible	--	--	--	--
Alkalinity (as $CaCO_3$)	--	--	--	--	--	--	--	128 to 135	--	150	75
Heavy metals	--	--	--	--	--	--	--	--	None	--	--
Calcium (Ca)	--	--	--	--	--	--	--	--	10	--	--
Magnesium (Mg)	--	--	--	--	--	--	--	--	5	--	--
Sulfate (SO_4)	--	--	--	--	--	--	--	--	100	--	--
Turbidity (as SiO_2)	--	--	--	--	--	--	--	--	--	50[k]	25[k]
Silica (soluble as SiO_2)	--	--	--	--	--	--	--	--	--	50	20
Calcium hardness (as $CaCO_3$)	--	--	--	--	--	--	--	--	--	--	50
Magnesium hardness (as $CaCO_3$)	--	--	--	--	--	--	--	--	--	--	50
Bicarbonate (as $CaCO_3$)	--	--	--	--	--	--	--	--	200	--	--

a. California State Water Quality Control Board, "Water Quality Criteria", Publication No. 3-A, 1963.
b. Depends on design of boiler.
c. Limits applicable only to feed water entering boiler, not to original supply.
d. Except where odor in live steam would be objectionable.
e. Water considered good enough to drink is considered safe for concrete unless otherwise noted.
f. California State Water Pollution Control Board, "A Survey of Direct Utilization of Waste Waters", Publication No. 12, 1955.
g. Groundwood papers are coarse papers composed primarily of groundwood fibers such as are used for newspapers, telephone directories, cheaper grades of catalogues, and pulp magazines.
h. Pulps produced by chemical cooking processes known as the soda process and the sulfate or kraft process are also called alkaline pulps.
j. Color in platinum units.
k. Materials causing turbidity shall not be gritty.



LEGEND

◉ WELL YIELDING WATER REPRESENTATIVE IN QUALITY OF THE OVERALL GROUND WATER SUPPLY IN COASTAL SAN DIEGO COUNTY

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY

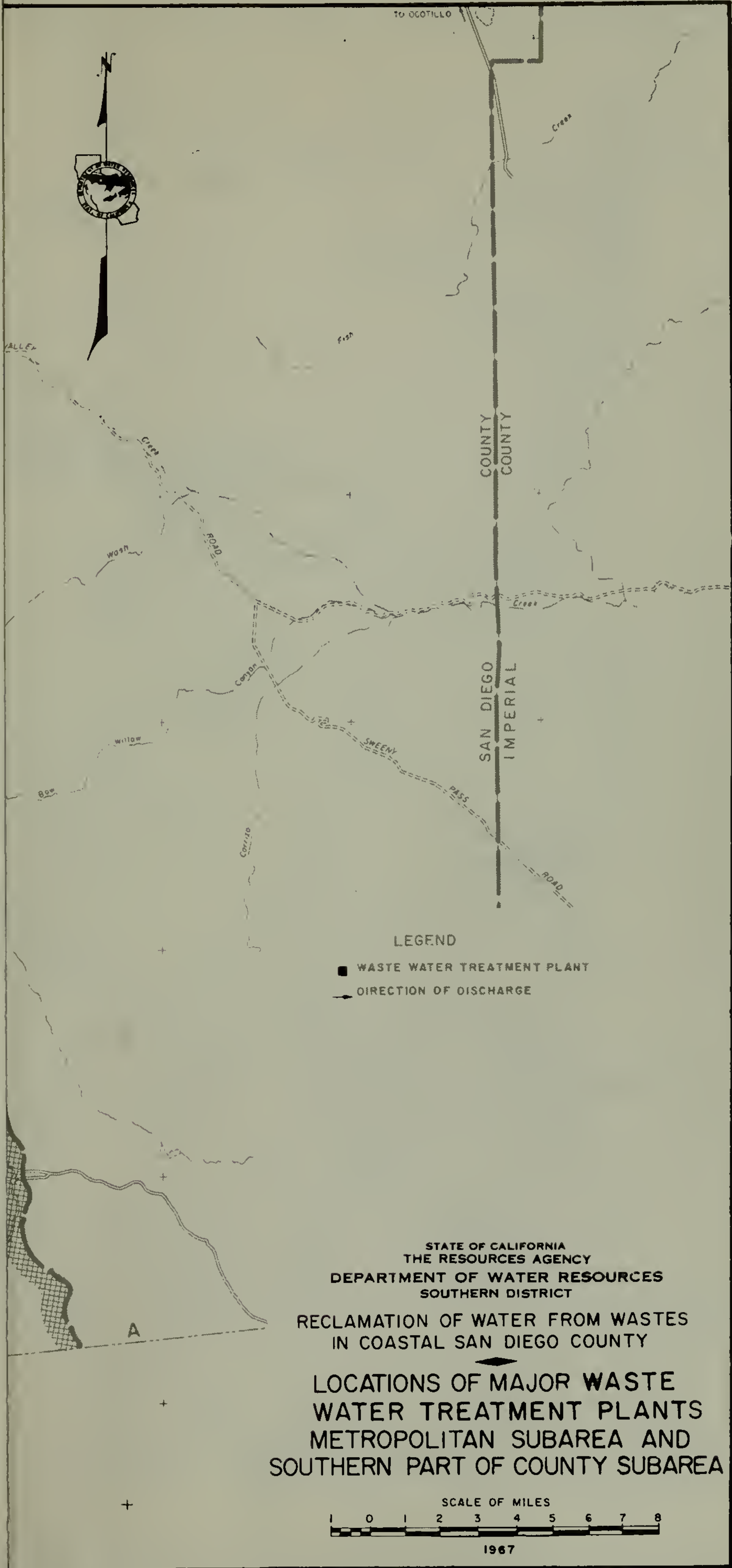
LOCATION MAP WITH MAJOR WATER SUPPLY FACILITIES AND LOCATION OF SAMPLING WELLS

SCALE OF MILES

4 0 4 8 12

1967


LOCATION OF
SAN DIEGO REGION
OREGON
NEVADA
ARIZONA
MEXICO
PACIFIC
OCEAN
SAN FRANCISCO
SACRAMENTO
LOS ANGELES
SAN DIEGO
LEGEND
WELL YIELDING WATER REPRESENTATIVE IN QUALITY OF THE OVERALL GROUND WATER SUPPLY IN COASTAL SAN DIEGO COUNTY
PACIFIC
OCEAN
PENINSULA
RANGE
CAMP PENDLETON SUBAREA
SAN DIEGO COUNTY SUBAREA
SAN DIEGO METROPOLITAN SUBAREA
RIVERSIDE CO
SAN DIEGO CO
ORANGE CO
RIVERSIDE CO
LAGUNA BEACH
SAN JUAN CAPISTRANO
SAN CLEMENTE
OCEANSIDE
CARLSBAD
LEUCADIA
ENCINITAS
CARDIFF
SOLANA BEACH
DEL MAR
LA JOLLA
MISSION BAY
PT LOMA
CORONADO
IMPERIAL BEACH
SAN DIEGO
NATIONAL CITY
CHULA VISTA
LA MESA
SPRING VALLEY
EL CAJON
LAKESIDE
SANTEE
POWAY
RAMONA
ESCONDIDO
SAN MARCOS
VISTA
FALLBROOK
RANCHO SANTA FE
SAN YSIDRO
OTAY
CAMPO
ALPINE
SANTA MARGARITA
SAN LUIS REY RIVER
SAN DIEGO RIVER
SAN DIEGUITO RIVER
SWEETWATER RIVER
OTAY RIVER
TIA JUANA R
TEMECULA RIVER
VAIL RESERVOIR
LAKE HENSHAW
SUTHERLAND RESERVOIR
CUYAMACA RESERVOIR
EL CAPITAN RESERVOIR
SAN VICENTE RESERVOIR
CHET HARRITT RESERVOIR
MIRAMAR RESERVOIR
MURRAY RESERVOIR
LAKE HODGES
LAKE WOHLFORD
LAKE LOVELAND
BARRETT LAKE
MORENA LAKE
SWEETWATER RESERVOIR
UPPER OTAY RESERVOIR
LOWER OTAY RESERVOIR
FIRST
SECOND
AQUEDUCT
ESCONDIDO CANAL
SUTHERLAND CONDUIT
DULZURA CONDUIT
CALIFORNIA
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
LOCATION MAP WITH
MAJOR WATER SUPPLY FACILITIES
AND LOCATION OF SAMPLING WELLS
SCALE OF MILES
4 0 4 8 12
1967



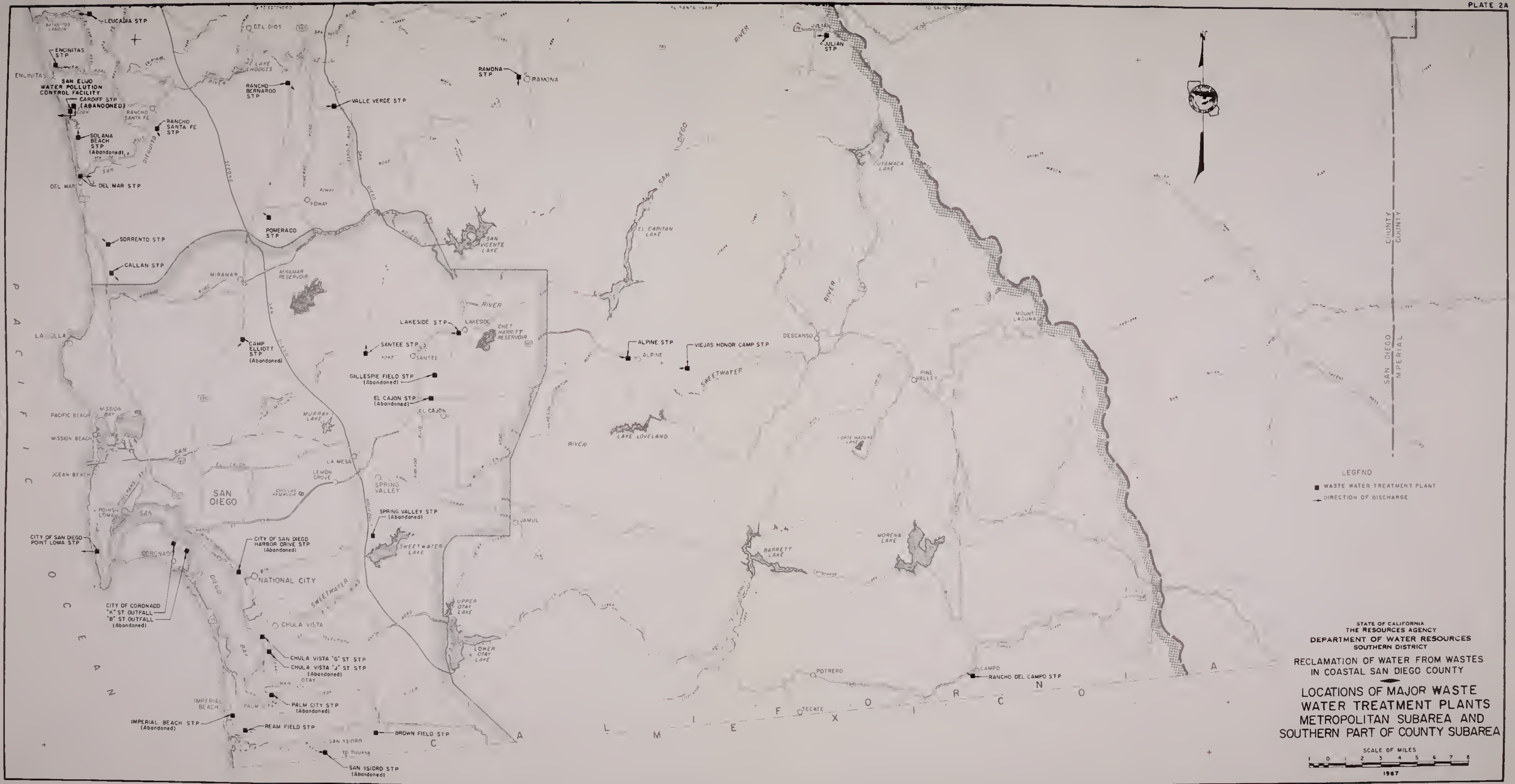
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

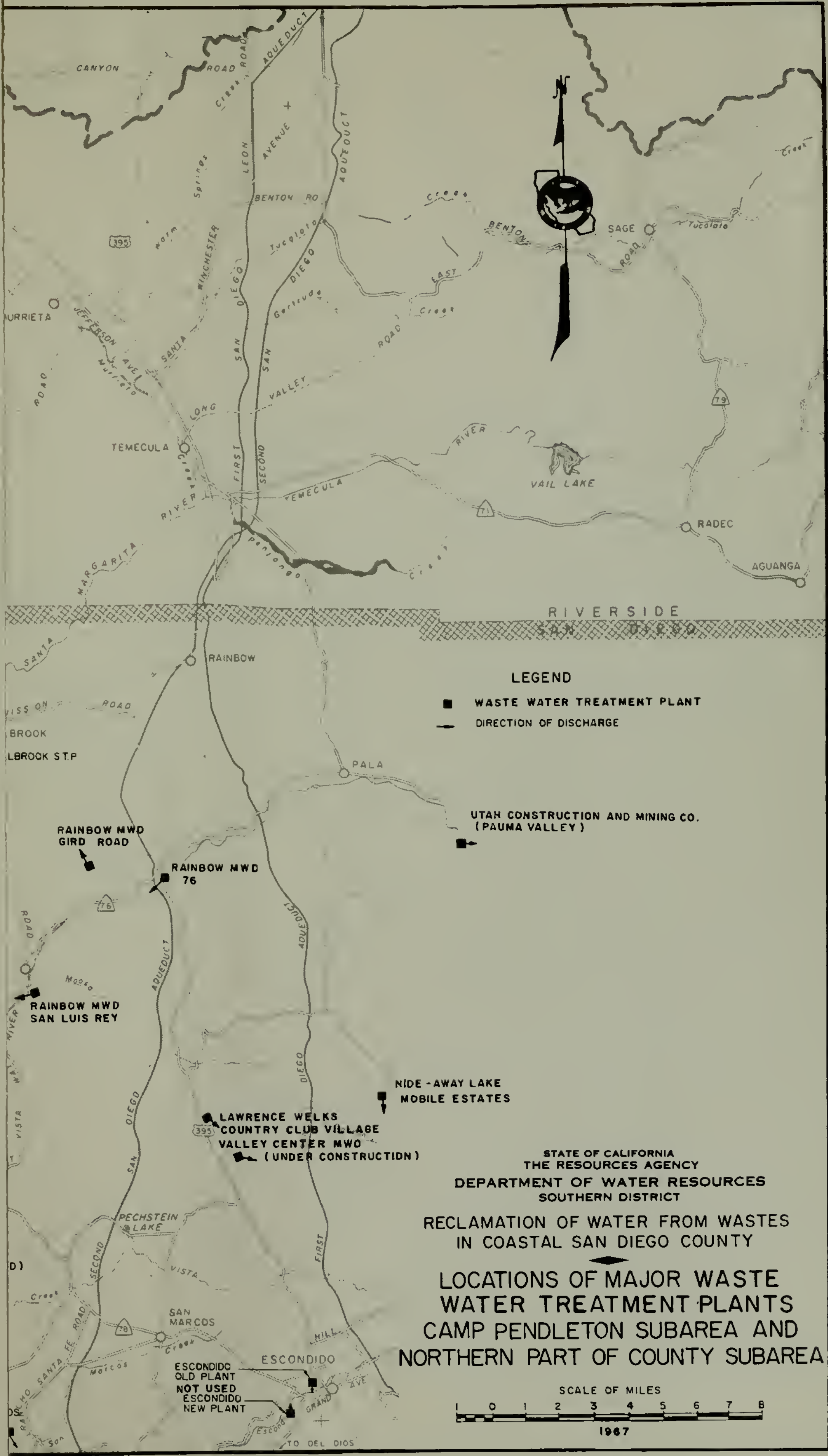
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY

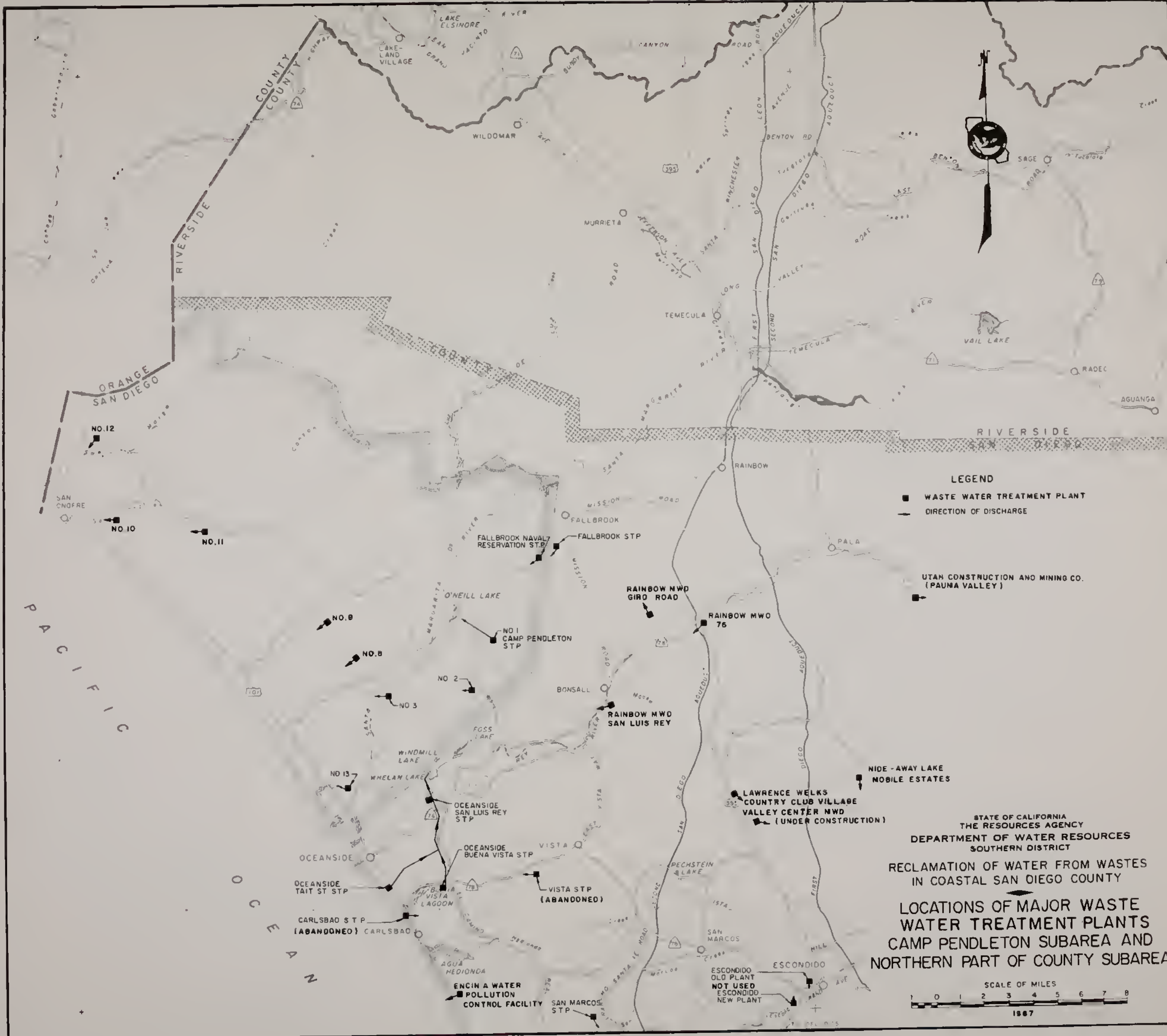
LOCATIONS OF MAJOR WASTE WATER TREATMENT PLANTS METROPOLITAN SUBAREA AND SOUTHERN PART OF COUNTY SUBAREA

1967

PLATE 2A


STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
LOCATIONS OF MAJOR WASTE
WATER TREATMENT PLANTS
METROPOLITAN SUBAREA AND
SOUTHERN PART OF COUNTY SUBAREA
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1967
LEGEND
WASTE WATER TREATMENT PLANT
DIRECTION OF DISCHARGE
LEUCADIA STP
ENCINITAS STP
ENCINITAS
SAN ELIJO WATER POLLUTION CONTROL FACILITY
CARDIFF STP (ABANDONED)
RANCHO SANTA FE STP
SOLANA BEACH STP (Abandoned)
DEL MAR
DEL MAR STP
SORRENTO STP
CALLAN STP
MIRAMAR
MIRAMAR RESERVOIR
POMERADO STP
POWAY
RANCHO BERNARDO STP
VALLE VERDE STP
RAMONA STP
RAMONA
DEL DIOS
LAKE HODGES
SAN VICENTE LAKE
EL CAPITAN LAKE
JULIAN STP
JULIAN
CUYAMACA LAKE
CAMP ELLIOTT STP (Abandoned)
LAKESIDE STP
LAKESIDE
CHET HARRITT RESERVOIR
SANTEE STP
SANTEE
GILLESPIE FIELD STP (Abandoned)
EL CAJON STP (Abandoned)
EL CAJON
ALPINE STP
ALPINE
VIEJAS HONOR CAMP STP
DESCANSO
SWEETWATER
PINE VALLEY
MOUNT LAGUNA
LA JOLLA
PACIFIC BEACH
MISSION BAY
MISSION BEACH
OCEAN BEACH
POINT LOMA
MURRAY LAKE
LA MESA
LEMON GROVE
SPRING VALLEY
SAN DIEGO
LAKE LOVELAND
SPRING VALLEY STP (Abandoned)
JAMUL
CITY OF SAN DIEGO POINT LOMA STP
CITY OF SAN DIEGO HARBOR DRIVE STP (Abandoned)
CORONADO
NATIONAL CITY
SWEETWATER LAKE
CITY OF CORONADO "K" ST OUTFALL "B" ST OUTFALL (Abandoned)
CHULA VISTA
UPPER OTAY LAKE
LOWER OTAY LAKE
BARRETT LAKE
MORENA LAKE
CHULA VISTA "G" ST STP
CHULA VISTA "J" ST STP (Abandoned)
OTAY
IMPERIAL BEACH
PALM CITY STP (Abandoned)
IMPERIAL BEACH STP (Abandoned)
REAM FIELD STP
BROWN FIELD STP
SAN YSIDRO
TO TIJUANA
SAN YSIDRO STP (Abandoned)
POTRERO
CAMPO
RANCHO DEL CAMPO STP
TECATE
PACIFIC OCEAN
CALIFORNIA
MEXICO
SAN DIEGO COUNTY
IMPERIAL COUNTY


LEGEND
WASTE WATER TREATMENT PLANT
DIRECTION OF DISCHARGE
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
LOCATIONS OF MAJOR WASTE
WATER TREATMENT PLANTS
CAMP PENDLETON SUBAREA AND
NORTHERN PART OF COUNTY SUBAREA
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1967
RIVERSIDE
SAN DIEGO
TEMECULA
URRIETA
SAGE
VAIL LAKE
RADEC
AGUANGA
RAINBOW
PALA
LBROOK S.T.P
UTAH CONSTRUCTION AND MINING CO.
(PAUMA VALLEY)
RAINBOW MWD
GIRD ROAD
RAINBOW MWD
76
RAINBOW MWD
SAN LUIS REY
HIDE-AWAY LAKE
MOBILE ESTATES
LAWRENCE WELKS
COUNTRY CLUB VILLAGE
VALLEY CENTER MWD
(UNDER CONSTRUCTION)
PECHSTEIN
LAKE
SAN
MARCOS
ESCONDIDO
ESCONDIDO
OLD PLANT
NOT USED
ESCONDIDO
NEW PLANT
FIRST SAN DIEGO AQUEDUCT
SECOND SAN DIEGO AQUEDUCT


LEGEND
WASTE WATER TREATMENT PLANT
DIRECTION OF DISCHARGE
STATE OF CALIFORNIA
THE RESOURCES AGENCY
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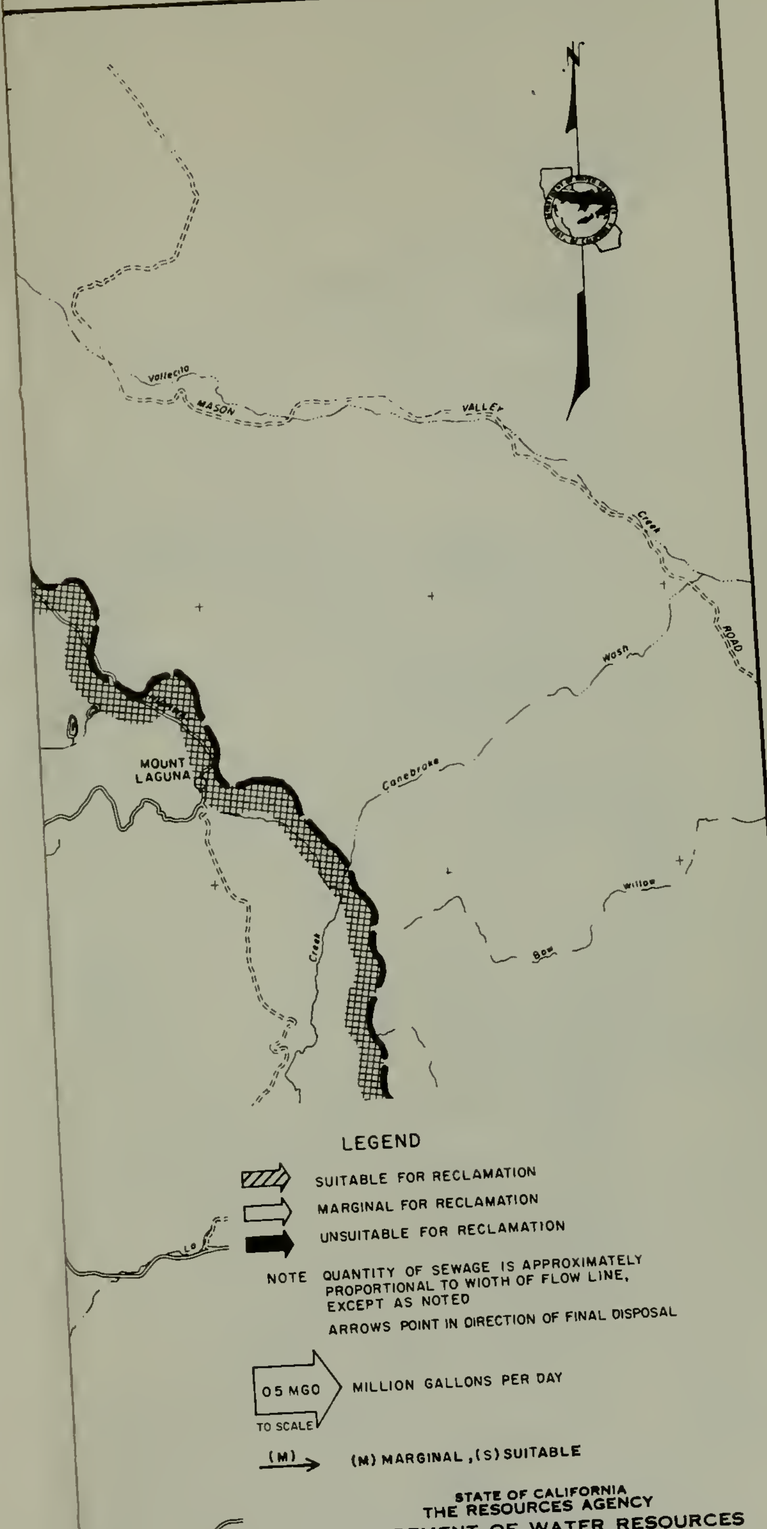
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
LOCATIONS OF MAJOR WASTE
WATER TREATMENT PLANTS
CAMP PENDLETON SUBAREA AND
NORTHERN PART OF COUNTY SUBAREA
SCALE OF MILES
1 0 1 2 3 4 5 6 7 8
1967
NO.12
NO.10
NO.11
NO.9
NO.8
NO 2
NO 3
NO 13
NO 1
CAMP PENDLETON
STP
FALLBROOK NAVAL
RESERVATION S.T.P.
FALLBROOK STP
RAINBOW NWD
GIRD ROAD
RAINBOW MWD
76
RAINBOW MWD
SAN LUIS REY
UTAH CONSTRUCTION AND MINING CO.
(PAUMA VALLEY)
HIDE-AWAY LAKE
MOBILE ESTATES
LAWRENCE WELKS
COUNTRY CLUB VILLAGE
VALLEY CENTER MWD
(UNDER CONSTRUCTION)
OCEANSIDE
SAN LUIS REY
STP
OCEANSIDE
BUENA VISTA STP
OCEANSIDE
TAIT ST STP
VISTA STP
(ABANDONED)
CARLSBAD S T P
(ABANDONED)
ENCINA WATER
POLLUTION
CONTROL FACILITY
SAN MARCOS
STP
ESCONDIDO
OLD PLANT
NOT USED
ESCONDIDO
NEW PLANT
PACIFIC OCEAN
ORANGE
SAN DIEGO
RIVERSIDE
COUNTY
RIVERSIDE
SAN DIEGO
LAKE ELSINORE
LAKE-LAND VILLAGE
WILDOMAR
MURRIETA
TEMECULA
VAIL LAKE
SAGE
RADEC
AGUANGA
RAINBOW
FALLBROOK
PALA
BONSALL
O'NEILL LAKE
WINDMILL LAKE
WHELAN LAKE
FOSS LAKE
OCEANSIDE
VISTA
CARLSBAD
BUENA VISTA LAGOON
AGUA HEDIONDA
SAN MARCOS
ESCONDIDO
PECHSTEIN LAKE
SAN ONOFRE



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY

QUANTITY AND MINERAL QUALITY OF SEWAGE FLOW FROM MAJOR SEWAGE DISPOSAL SYSTEMS, 1960-62 METROPOLITAN SUBAREA AND SOUTHERN PART OF COUNTY SUBAREA

SCALE OF MILES
1 0 1 2 3 4 5 6 7 8

1967

PLATE 3A

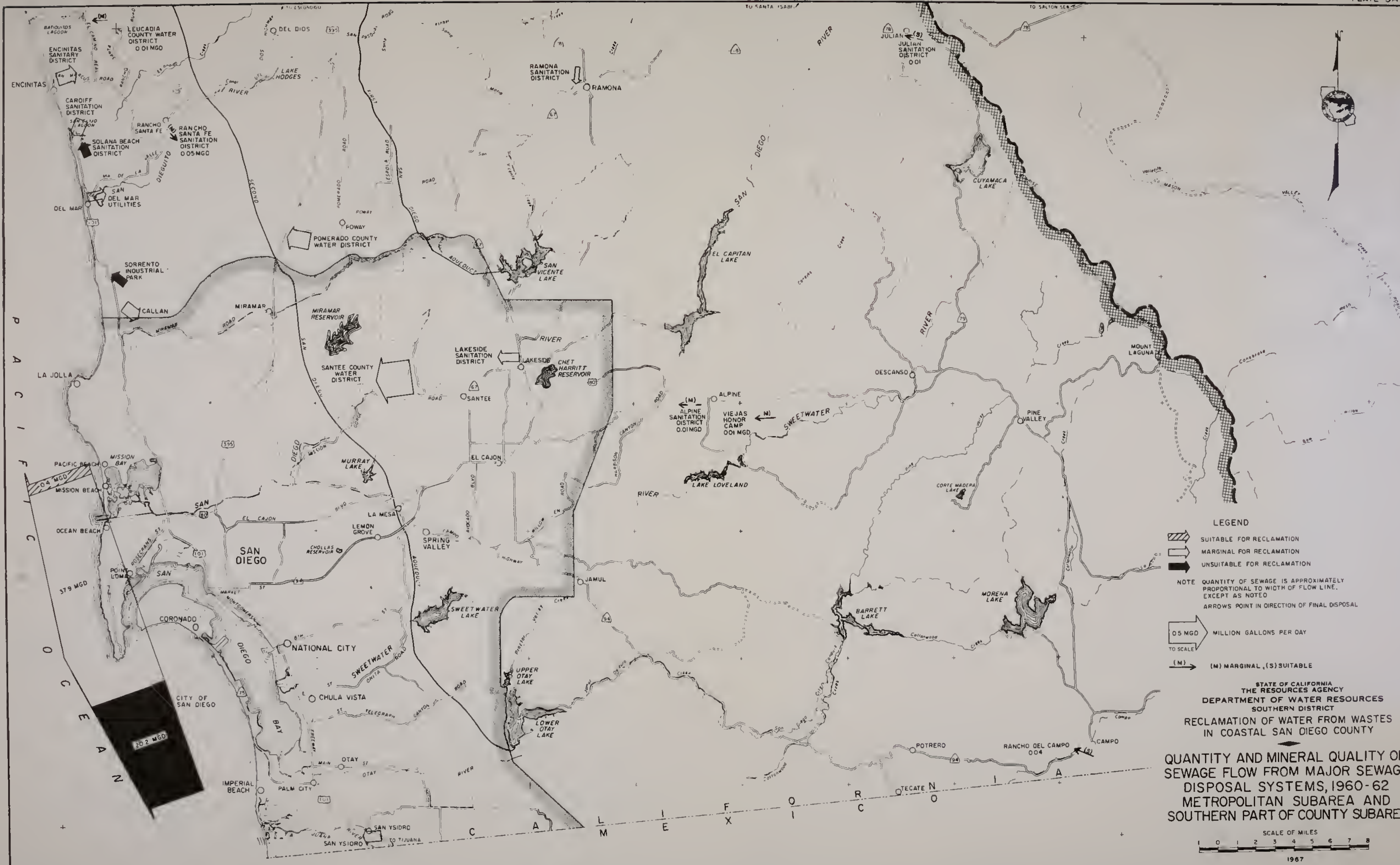
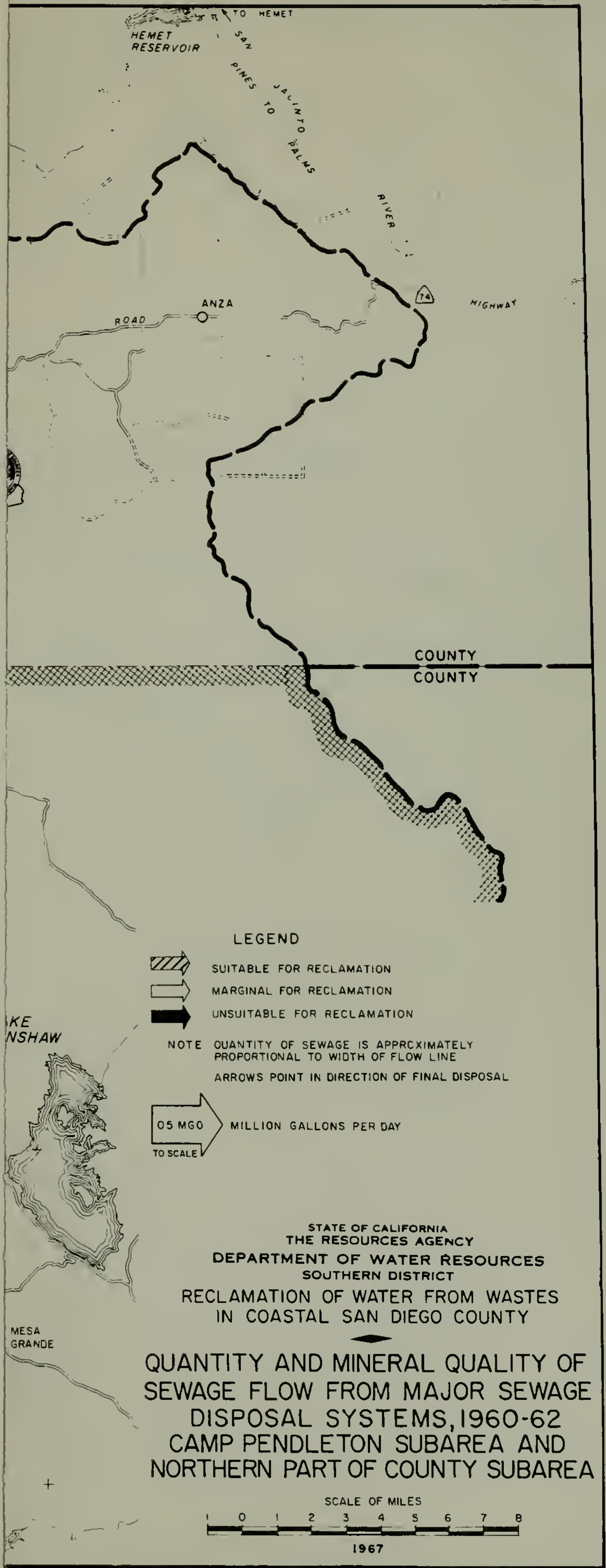

LEGEND
SUITABLE FOR RECLAMATION
MARGINAL FOR RECLAMATION
UNSUITABLE FOR RECLAMATION
NOTE QUANTITY OF SEWAGE IS APPROXIMATELY PROPORTIONAL TO WIDTH OF FLOW LINE, EXCEPT AS NOTED
ARROWS POINT IN DIRECTION OF FINAL DISPOSAL
0.5 MGD MILLION GALLONS PER DAY
TO SCALE
(M) MARGINAL, (S) SUITABLE
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES IN COASTAL SAN DIEGO COUNTY
QUANTITY AND MINERAL QUALITY OF SEWAGE FLOW FROM MAJOR SEWAGE DISPOSAL SYSTEMS, 1960-62
METROPOLITAN SUBAREA AND SOUTHERN PART OF COUNTY SUBAREA
SCALE OF MILES
1967
LEUCADIA COUNTY WATER DISTRICT 0.01 MGD
ENCINITAS SANITARY DISTRICT
ENCINITAS
CARDIFF SANITATION DISTRICT
SOLANA BEACH SANITATION DISTRICT
RANCHO SANTA FE SANITATION DISTRICT 0.05 MGD
SAN DEL MAR UTILITIES
DEL MAR
SORRENTO INDUSTRIAL PARK
CALLAN
POMERADO COUNTY WATER DISTRICT
POWAY
DEL DIOS
LAKE HODGES
RAMONA SANITATION DISTRICT
RAMONA
JULIAN
JULIAN SANITATION DISTRICT 0.01
CUYAMACA LAKE
SAN VICENTE LAKE
EL CAPITAN LAKE
MIRAMAR
MIRAMAR RESERVOIR
SANTEE COUNTY WATER DISTRICT
LAKESIDE SANITATION DISTRICT
LAKESIDE
CHET HARRITT RESERVOIR
SANTEE
LA JOLLA
ALPINE SANITATION DISTRICT 0.01 MGD
ALPINE
VIEJAS HONOR CAMP 0.01 MGD
DESCANSO
PINE VALLEY
MOUNT LAGUNA
PACIFIC BEACH
MISSION BAY
0.4 MGD
MISSION BEACH
MURRAY LAKE
EL CAJON
LAKE LOVELAND
OCEAN BEACH
LA MESA
LEMON GROVE
SPRING VALLEY
SAN DIEGO
CHOLLAS RESERVOIR
POINT LOMA
37.9 MGD
JAMUL
CORONADO
NATIONAL CITY
SWEETWATER LAKE
BARRETT LAKE
MORENA LAKE
CORTE MADERA LAKE
CITY OF SAN DIEGO
20.2 MGD
CHULA VISTA
UPPER OTAY LAKE
LOWER OTAY LAKE
OTAY
PALM CITY
IMPERIAL BEACH
SAN YSIDRO
TO TIJUANA
POTRERO
RANCHO DEL CAMPO 0.04
CAMPO
TECATE
PACIFIC OCEAN
CALIFORNIA
MEXICO

PLATE 3B



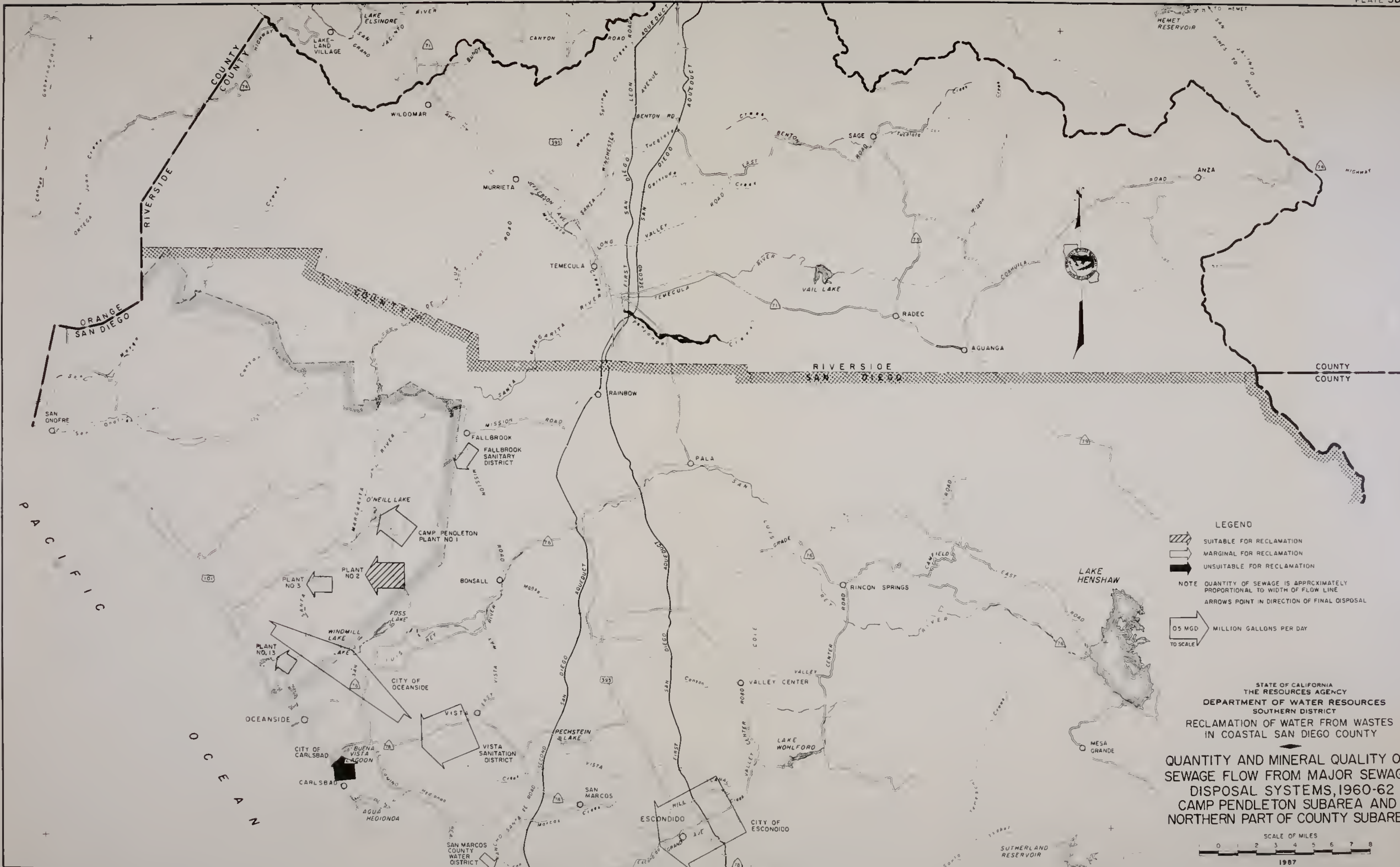
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY

QUANTITY AND MINERAL QUALITY OF SEWAGE FLOW FROM MAJOR SEWAGE DISPOSAL SYSTEMS, 1960-62
CAMP PENDLETON SUBAREA AND NORTHERN PART OF COUNTY SUBAREA

SCALE OF MILES
1 0 1 2 3 4 5 6 7 8

1967


STATE OF CALIFORNIA
THE RESOURCES AGENCY
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SOUTHERN DISTRICT
RECLAMATION OF WATER FROM WASTES
IN COASTAL SAN DIEGO COUNTY
QUANTITY AND MINERAL QUALITY OF SEWAGE FLOW FROM MAJOR SEWAGE DISPOSAL SYSTEMS, 1960-62
CAMP PENDLETON SUBAREA AND NORTHERN PART OF COUNTY SUBAREA
SCALE OF MILES
0 1 2 3 4 5 6 7 8
1987
LEGEND
SUITABLE FOR RECLAMATION
MARGINAL FOR RECLAMATION
UNSUITABLE FOR RECLAMATION
NOTE QUANTITY OF SEWAGE IS APPROXIMATELY PROPORTIONAL TO WIDTH OF FLOW LINE
ARROWS POINT IN DIRECTION OF FINAL DISPOSAL
0.5 MGD
TO SCALE
MILLION GALLONS PER DAY
PACIFIC OCEAN
RIVERSIDE COUNTY
SAN DIEGO COUNTY
ORANGE COUNTY
LAKE ELSINORE
LAKELAND VILLAGE
WILDOMAR
MURRIETA
TEMECULA
VAIL LAKE
SAGE
ANZA
RADEC
AGUANGA
HEMET RESERVOIR
RAINBOW
SAN ONOFRE
FALLBROOK
FALLBROOK SANITARY DISTRICT
PALA
O'NEILL LAKE
CAMP PENDLETON PLANT NO 1
PLANT NO 2
PLANT NO 3
PLANT NO. 13
BONSALL
FOSS LAKE
WINDMILL LAKE
CITY OF OCEANSIDE
OCEANSIDE
VISTA
VISTA SANITATION DISTRICT
CITY OF CARLSBAD
BUENA VISTA LAGOON
CARLSBAD
AGUA HEDIONDA
PECHSTEIN LAKE
SAN MARCOS
SAN MARCOS COUNTY WATER DISTRICT
ESCONDIDO
CITY OF ESCONDIDO
RINCON SPRINGS
VALLEY CENTER
LAKE WOHLFORD
LAKE HENSHAW
MESA GRANDE
SUTHERLAND RESERVOIR
SAN DIEGO AQUEDUCT
FIRST SAN DIEGO AQUEDUCT
SECOND SAN DIEGO AQUEDUCT